TECHNOLOGY DEPT:

NATIONAL PETROLEUM NEWS

DETROIT

Volume 35 June 2, 1943 Number 22

HIGHLIGHTS OF THE WEEK'S NEWS

'Gas' Cut Coming for Mid-West?

Ickes hints it may as East moves into second week of motor fuel famine with "B" and "C" rationing coupons cut to 2.5 gal. each—and no relief in sight. ODT, PAW, OPA issue emergency orders to keep essential transportation moving despite shortage. **P. 3.**

Wartime Farmer is Big Oil User

U. S. Department of Agriculture estimates 1943 farm demand for petroleum products by states, with U. S. totals as follows: 3,170,640,175 gal. of gasoline; 491,104,500 gal. of fuel oil; 488,711,000 gal. of kerosine; 40,110,600 gal. of lubricating oil (not counting lubricating oil for farm tractors); and 92,833,600 lbs. of grease. **P. 26.**

How an Alky-Rubber Plant Works

Newsmen tour government-owned alcohol-butadiene rubber project at Institute, W. Va.; watch manufacture of Buna S rubber from scratch. Plant, costing $56,000,000, is rated to produce one-seventh of nation's pre-war rubber demand. **P. 18.**

New Rate-Weight for Gasoline?

ICC orders establishment of 4.7 lbs. per gal. weight for liquefied petroleum gas from Mid-Continent to southern territory in move that may open the door to reconsideration of estimated weights, for freight purposes, of other petroleum products. **P. 22.**

100-Octane Cuts Diesel Supply

Authority predicts Diesel fuels will be on critical list by end of 1944 if present rate of production of high octane aviation gasoline at the expense of kerosine and distillate yields continues at present rate. **P. 16.**

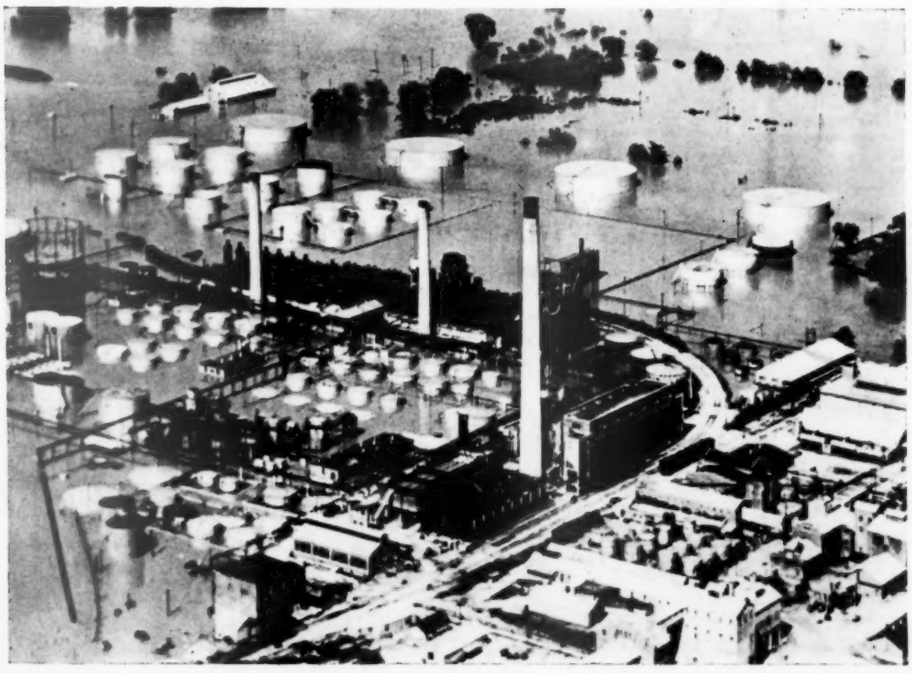
Marketing Distribution Essentiality

PAW drafts plan to provide proof of "local necessity" of distribution manpower, area by area, as WMC refuses to put distrubution on "essential" list. Burden of proving oil marketers in a given area are getting along with only minimum manpower rests with marketers themselves. **P. 6.**

Nye Bill Ires Texas Senators

North Dakota senator's move to reintroduce his bill permitting U. S. to take over off-shore lands finds heated opposition in Texas Senators Connally and O'Daniel. **P. 28.**

General News . . . p. 3, Washington News . . . p. 6, The Editor's Page . . . p. 13, Refining News . . . p. 16, Production News . . . p. 28, Transportation News . . . p. 22, Statistics . . . p. 34, Markets . . . p. 33, Personals . . . p. 43.



The Verdigris River (a Mississippi tributary) on the rampage swept over the Coffeyville, Kans., refinery of National Refining Co. in the same flood that washed out the "big inch" line

BULLETINS

DESIGNATE 'WAR WORKER' STATIONS

NEW YORK — Twenty-five "war worker" gasoline stations have been designated to date by Army and Navy in East Coast area. These are stations selected by war plants and certified by Army or Navy to serve workers of the plants exclusively in a plan designed to assure gasoline supplies for war workers' cars. Eighteen of the stations thus far selected are in Baltimore; 7 are on Long Island (N. Y.). Army and/or Navy tells PAW which stations should get preference on gasoline deliveries and PAW sees that such preference is given.

* * *

ASSURES SUPPLY FOR FISHERMEN

NEW YORK—H. W. Dodge, District 1 PAW director-in-charge, has written eastern suppliers that "it is important that we remove any obstacles involving the supply of either gasoline or Diesel fuel which may hinder commercial fishing operations." Dodge told suppliers to notify their bulk plants of importance of keeping fishing industry adequately supplied. "If they are unable to deliver the necessary requirements of commercial fisheries, you are requested to notify this office immediately." Dodge said upon receipt of this information a directive will be issued to assure supplies for such accounts if the PAW District 1 office deems necessary.

* * *

SEEK COMPENSATION FOR OVERTIME

WASHINGTON — PIWC has instructed its cost and price adjustment committee to look into the matter of obtaining extra compensation for added costs of going on a 48-hour week in oil distribution. Resolution was adopted by the Council upon recommendation of its marketing committee.

PIWC's manpower committee is asking the Council to obtain government permission to increase salaries of supervisors when operations go to 48 hours per week. Under the 48-hour week order, wages may be increased time and a half for the extra hours, but no provision is made for supervisors. Internal Revenue Bureau has indicated it will consider applications for salary increases due to overtime but has not yet announced any standards.

* * *

ASK DEFERMENT OF SAFETY RULES

WASHINGTON — PIWC has urged PAW Ickes to ask ICC to defer, until after the war, application of its tank truck safety rules to private trucks and all intrastate trucks, including local bulk plant delivery trucks. PIWC's resolution June 1 said that new equipment and materials needed to meet regulations are virtually unobtainable, that too much manpower would be required to install it, and that operating rules would slow down deliveries. (See earlier story on p. 3).

REFINERY MANAGEMENT AND PETROLEUM CHEMICAL TECHNOLOGY EDITION—In 2 Sections, Section 1

ARMY E NAVY

KEEP THEM
FLYING
ROLLING
SAILING

OIL IS AMMUNITION
USE IT WISELY

BUY MORE WAR BONDS AND STAMPS

MORRISON BROS. COMPANY
OIL EQUIPMENT HEADQUARTERS
DUBUQUE, IOWA

NPN's WASHINGTON DIRECTORY of Oil Agency Headquarters

Following is a partial list and directory of governmental agencies in Washington dealing with matters affecting the oil industry. (List is as accurate as possible but is only tentative as room and phone numbers are constantly changing.)
Abbreviations code: Rm for room; Ex for phone extension.

Office of Petroleum Administration for War

New Interior Bldg., 18th and C Sts., N.W.
Phone REpublic 1820

General Information—**Mrs. Rosalie E. Reid,** Rm 6635, Ex 3429-4820.

Administrator
Harold L. Ickes, Rm 6000, Ex 5000.

Deputy Petroleum Administrator
Ralph K. Davies, Rm 6654, Ex 3831.
Bernice Kirschling, personal assistant to Davies, Rm 6654, Ex 3831.
H. Chandler Ide, special assistant to Davies, Rm 6654, Ex 3833.
Dr. Frederick H. Harbison, labor counselor, Rm 6640, Ex 2054.

Special Assistants
Joseph A. Fanelli, Rm 6132, Ex 5084.
Dr. John W. Frey, Rm 7424, Ex 4272.

Assistant Deputy Petroleum Administrators
Robert E. Allen, Rm 6514, Ex 4401.
Adolph H. Levy, special assistant to Allen, Rm 7514, Ex 4838.
Elmer E. Batzell, special assistant to Allen, Rm 6526, Ex 2181.
Earl J. Opal, chief of review and clearance section, Rm 5226, Ex 2156.
Bruce K. Brown, Rm 6643, Ex 4711.
George E. Dewey, special assistant to Brown, Rm 6642, Ex 3826.
E. DeGolyer, asst. deputy administrator, Rm 6631, Ex 2151.

Administrative Division
Eric L. Kohler, executive officer, Rm 6415, Ex 4174.
E. J. Skidmore, Director, Rm 6412, Ex 4363.

Public Relations Division
Gordon Sessions, director, Rm 7515, Ex 3161.
Herbert A. Yocom, assistant director, Rm 7515, Ex 3181.

Division of Reserves
William B. Heroy, director, Rm 7455, Ex 4454.

Facility Security Division
Allen A. Jergins, director, Rm 5213, Ex 4172.

Foreign Division
James T. Duce, director, Rm 4212, Ex 4417.
William D. Crampton, associate director, Rm 4211, Ex 4788.
C. Stribling Snodgrass, associate director, Rm 4218, Ex 2968.
A. H. Chapman, assistant to director, Rm 4214, Ex 2655.

Legal Division
J. Howard Marshall, chief counsel, Rm 6515, Ex 3112.
Mortimer A. Kline, associate chief counsel, Rm 6519, Ex 4481.
Robert E. Friedman, assistant chief counsel, Rm 6519, Ex 3114.
Wallace E. Avery, principal attorney marketing division, Rm 4246, Ex 2978.
George A. Wilson, principal attorney transportation division, Rm 5408, Ex 4898.
Justin R. Wolf, assistant chief counsel, Rm 6525, Ex 2130.
Malvin R. Mandelbaum, acting principal attorney, refining div., Rm 5328, Ex 3546.

Marketing Division
Walter Hochuli, director, Rm 4257, Ex 4646.
D. C. Arnold, chief of asphalt section, Rm 4022, Ex 2787.
Howard Cooper, chief of lube oils and containers section, Rm 4244, Ex 4313.
Robert W. MacMillan, chief of marketing equipment section, Rm 4040, Ex 2781.
Kenneth Darling, chief fuel oil section, Rm 4251, Ex 4440.
A. I. Hocking, acting chief, joint use of facilities section, Rm 4347, Ex 4751.
John Downing, chief of motor fuels section, Rm 4026, Ex 2881.
Joseph H. Thompson, chief of administrative section, Rm 4255, Ex 4797.

Materials Division
Frank A. Watts, director, Rm 1444, Ex 4585.
Howard C. Turner, assistant director, Rm 1545, Ex 2736.

Natural Gas and Natural Gasoline Division
E. Holley Poe, director, Rm 7314, Ex 4736.
Paul M. Raigorodsky, assistant director, Rm 7316, Ex 4774.
James E. Pew, chief of natural gasoline section, Rm 7320, Ex 4871.
Robert W. Ducker, chief of natural gas section, Rm 7324, Ex 2524.
Paul K. Thompson, chief, liquefied petroleum gas section, Rm 7348, Ex 3448.

Petroleum Supply Division
(Vacant) director, Rm 5210, Ex 2081.
R. C. Sauer, assistant director, Rm 5212, Ex 2081.
Lucien Craig, assistant director, Rm 5224, Ex 2029.

Production Division
Donald R. Knowlton, director, Rm 7410, Ex 4231.
Ralph J. Schilthuis, assistant director, Rm 7416, Ex 2907.
Millard K. Neptune, chief, production operations, Rm 7413, Ex 4826.
David G. Hawthorne, chief of equipment section, Rm 7418, Ex 2062.
Joseph Gordon, chief economics and supply section, Rm 7454, Ex 2984.
R. V. Shirk, chief, reclamation, Rm 7444, Ex 2453.
M. G. Hoffman, chief, facilities, Rm 7427, Ex 4509.
Lt. Milton Williams, chief, development, Rm 7425, Ex 2094.

Refining Division
E. D. Cumming, director, Rm 5257, Ex 3233.
Robert B. Cragin, asst. director, Rm 5024, Ex 3237.
Douglas P. Bailey, chief of operations section, Rm 5040, Ex 4877.
Max B. Miller, chief of construction section, Rm 3312, Ex 4560.
George Parkhurst, chief of new facilities section, Rm 5260, Ex 3941.
Dr. M. R. Mandelbaum, chief of process section, Rm 5328, Ex 4832.

Research Division
Edward B. Swanson, director, Rm 7315, Ex 649.
C. D. Lockwood, assistant director, Rm 7317, Ex 4777.

Transportation Division
Maj. J. R. Parten, director, Rm 5412, Ex 4418.
W. C. Kinsolving, assistant director, Rm 5418, Ex 3557.
Lee R. Cowles, assistant director, Rm 5413, Ex 3658.
Walter B. Lange, assistant director and secretary, Petroleum Supply & Distribution Board, Rm 5323, Ex 4744.
Don F. Sears, chief of pipeline section, Rm 5045, Ex 4833.
Joseph A. Winterberger, chief of tank car section, Rm 5327, Ex 4744.
Boyd Wilson, chief, rail transport section, Rm 5423, Ex 4620.
S. D. Archbold, chief of inland waterways section, Rm 5319, Ex 4333.
John Arch Turner, chief of truck transportation section, Rm 5427, Ex 4300.
Frank I. Brinegar, chief of appraisal section, Rm 5420, Ex 4627.

WPB Representatives at PAW
R. R. McLachlen, Controlled Materials Plan representative, Rm 6520, Ex 4616.
M. C. Schoenly, distribution officer, Rm 1550, Ex 4617.

Liaison
Gen. Walter B. Pyron
Liaison agent between Army and all governmental agencies handling petroleum, Rm 4D577, Ex 5042, Pentagon Bldg., Arlington, Va., REpublic 6700.

Office of Defense Transportation

ICC Bg—Interstate Com. Com. Bldg., 14th and Constitution Ave.
New PO Bg—New Post Office Bldg., 1200 Pennsylvania Ave., N.W.
Barber & Ross Bg—11th and G Streets, N.W.
Tower Bg—14th and K Streets, N.W.
Phone REpublic 7500

General Information, Ex 3550.
Office of the Director
Joseph B. Eastman, director, Rm 5136, ICC Bg—Ex 3527.
Division of Materials and Equipment
H. H. Kelly, director, Rm 2121, ICC Bg—Ex 2206.
Waterways Transport
Ernest Holzborn, asst. O.D.T. director in charge, Rm 5412, ICC Bg—Ex 3616.
Division of Coastwise & Intercoastal Transport
Charles F. Kellers, director, Rm 5412, ICC Bg—Ex 71560.
Division of Inland Waterways
Glenn Taylor, director, Rm 5412, ICC Bg—Ex 3624.
Division of Great Lakes
A. T. Wood, director, Rm 5412, ICC Bg—Ex 3624.
Headquarters 2209 Terminal Bldg., Cleveland, O., CHerry 7900.
Division of Motor Transport
John L. Rogers, director, Rm 4211, ICC Bg—Ex 2297.
Petroleum Carriers Section
Samuel F. Niness, chief, Rm 2406, New PO Bg—Ex 6351.
Division of Petroleum & Other Liquid Transport
Fayette B. Dow, director, Rm 5132, ICC Bg—Ex 73207.
Porter L. Howard, associate director, Rm 5312, ICC Bg—Ex 72795.
Major Joseph E. Keller, transportation corps and consultant on state barriers, Rm 2367, ICC Bg—Ex 72216
H. E. Covl, consultant, Rm 5310, ICC Bg—Ex 74155.
Pipe Line Section
R. W. Shields, assoc. director, Rm 6310, ICC Bg—Ex 2635.
Tank Car Service Section
A. V. Bourque, assoc. director, Rm 4318, ICC Bg—Ex 75407.
Division of Transport Personnel
Otto S. Beyer, director, Rm 2111, New PO Bg—Ex 71857.

Office of Price Administration

FO Bg 1—Federal Office Building No. 1, 2nd & D Street, S.W.
Temp D Bg—Temporary D Building, 4th and Independence Ave., S.W.
Temp S Bg—Temporary S Building, 4th and Jefferson Drive, S.W.
Phone REpublic 7500

General Information, Ex 5583.
Office of the Administrator
Prentiss M. Brown, National Price Administrator, Rm 4130, FO Bg 1—Ex 5586.
Clyde Herring, Sr., asst. to the administrator, Rm 1130, FO Bg 1—Ex 76307.
Price
J. Kenneth Galbraith, deputy administrator, Rm 5131, FO Bg 1—Ex 5203.
Fuels Division
Sumner T. Pike, director, Rm 6306, FO Bg 1—Ex 76288.
Petroleum Price Branch
Orville Judd, price executive, Rm 6307, FO Bg 1—Ex 5388.
Crude Oil Production Section
Watson B. Joyes, chief, Rm 6315, FO Bg 1—Ex 4403.
Refinery Technique Section
Edward I. Shaeffer, chief, Rm 6316, FO Bg 1—Ex 6226.
Fuel Oil Unit
Peter Jensen, chief, Rm 6314, FO Bg 1—Ex 4916.
Gasoline Unit
Eugene Uman, chief, Rm 6314, FO Bg 1—Ex 6085.
Asphalt Unit
Francis P. Smith, Jr., chief, Rm 6314, FO Bg 1—Ex 73583.
Lubricating Oils Unit
Benjamin Goldberg, chief, Rm 6314, FO Bg 1—Ex 73583.
Refined Products, Retail Section
Charles W. Grenz, chief, Rm 6315, FO Bg 1—Ex 73584.
Fuel Rationing Division
Joel Dean, director, Rm 258, Tem D Bg—Ex 73411.

War Production Board

FHLB—Federal Home Loan Bldg., 2nd and D Sts., S.W.
NMB—New Municipal Bldg., 300 Indiana Ave., N.W.
RRB—Railroad Retirement Bldg., 3rd and C Sts., S.W.
SSB—Social Security Bldg., 4th and Independence Ave., S.W.
WGLB—Washington Gas Light Bldg. 1100 H St., N.W.
Phone REpublic 7500

Executive Office of the Chairman
Donald M. Nelson, chairman, Rm 5055, SSB—Ex 2113.
Smaller War Plants Corporation
Col. Robert W. Johnson, vice-chairman, Rm 316, FHLB—Ex 72318.
Office of Rubber Director
William M. Jeffers, director, Rm 5014, NMB—Ex 3256.
Col. Bradley Dewey, deputy director, Rm 5007, NMB—Ex 2455.
Executive Vice Chairman
C. E. Wilson, Rm 5037, SSB—Ex 2134.
Petroleum Unit
Robert T. Lawrence, chief, 9 Fl. WGLB—Ex 72355.

Congress

Congressional Oil Investigating Committee
"Lea Committee"
Rep. Clarence F. Lea, Calif., chairman, New House Office Bldg., Rm 1535, Ex 699.
Senate Oil Shortage Investigating Committee
"Maloney Committee"
Sen. Francis Maloney, chairman, Senate Office Bldg., Rm 354, Ex 1196, Phone NAtional 3120.

Petroleum Industry War Council

Rm 919 Commonwealth Bldg., 1625 K St., N. W., Phone DIstrict 2820.
William R. Boyd, Jr., chairman.
Allan H. Hand, secretary-treasurer.

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Otto D. Donnell . . .
Heads District 2 General Committee

Practically ever since the dawn of the New Deal the names "government oil committee" and "Otto D. Donnell" have been almost synonymous. Although Otto Donnell may not have always agreed with New Deal policies, he has given generously of his time and strength in service on the various committees the present administration has created in its attempts to cure the country's economic ailments. He has been making tracks between Findlay, Ohio and Washington, D. C. for many years.

In 1933 Mr. Donnell shared in the work of framing an operating code for the petroleum industry under the National Industrial Recovery Act. Following Presidential approval of the Code, he was made chairman of the production committee for the third regional district, covering 12 Mid-Western states.

After 10 New Deal years, Mr. Donnell—a Republican—is still called upon to serve when any government oil committees are formed. Currently, he is chairman of the general committee for District 2, a position in which he succeeded Frank Phillips, Bartlesville, Phillips Petroleum Co. Since the formation of the petroleum industry district committees in July, 1941, he has been chairman of the production committee for District 2, and since the Petroleum Industry War Council was formed in December, 1941, he has headed up its production committee. He resigned the District 2 production committee chairmanship when he became District 2 general committee chairman.

Mr. Donnell's background fits him for positions of leadership in matters pertaining to oil because he "grew up" with the oil business. His father, James C. Donnell, was an oil operator practically all his life. An associate of the late John D. Rockefeller, the elder Donnell, at the time of his death in 1927, was one of the leaders in the petroleum industry in the U. S.

Otto Donnell was born in Allentown, N. Y., but was educated in Ohio—in Findlay and at Case School of Applied Science in Cleveland where he obtained his B. S. degree in mechanical engineering. He really entered the oil business as a mechanical engineer in Ohio Oil Co.'s pipeline department at Marshall, Ill., although, as a Findlay High School student, he worked after school and during vacations as an office boy at Ohio Oil's headquarters.

His climb up the ladder was rapid: in 1910 he was elected to the Board of Directors; 3 years later he became second vice-president and assistant general manager; and 9 years after that, first vice-president and treasurer. Upon the death of his father—who had headed the company for 16 years—Otto Donnell succeeded him as president and general manager of Ohio Oil Co. As president he assumed control of a company having assets in excess of $180,000,000 and one engaged in the production, purchase, transportation, refining and marketing of petroleum and its products in 23 states of the U. S. and in Mexico. In addition to heading this large industrial organization, Mr. Donnell is a director of the Erie Railroad Co., and of the Andian National Corp., Toronto, Canada; and chairman of the board of the First National Bank in Findlay.

Since the organization of the American Petroleum Institute in 1919, Mr. Donnell has served on many committees and, since 1927, has been a member of A.P.I.'s Board of Directors, representing the Eastern group. At present he is also A.P.I. treasurer. He is a trustee and member of the corporation of the Case School of Applied Science and several years ago served as a member and, ultimately, as president of the Findlay School Board.

Mr. Donnell holds membership in the United States, the Ohio and the Findlay Chambers of Commerce and in Phi Kappa Psi Fraternity. He is a 32nd degree Mason and is also on the membership rolls of the Findlay Rotary Club and the New York and Congressional Country Clubs of Washington, D. C.

NATIONAL PETROLEUM NEWS

VOLUME 35 WEDNESDAY, JUNE 2, 1943 NUMBER 22

New Safety Regulations On Tank Trucks Feared by Oil Men

NPN News Bureau

WASHINGTON—Oil companies are worried about ICC applying its tank truck safety regulations to intrastate movements, including trucks making local deliveries from bulk plants. They are thinking of asking ICC to reconsider its action or at least to postpone the effective date, June 15.

ICC has applied its regulations covering "explosives and other dangerous articles" to interstate private trucks and intrastate trucks both private and for-hire (interstate for-hire trucks were already covered).

There are 2 sets of regulations. One set applies to tank specifications and handling of inflammable cargo. The other regulations cover operations including driver's hours (60-hour week, 10-hour day followed by at least 8 hours off), driver's log and driving rules as well as lights, ignition, flares and other truck equipment. These regulations were issued under ICC Order 3666 and Ex Parte MC-3 and MC-13 on May 12.

ICC Defends Regulations

ICC said extension of these rules to local operations was made necessary by wartime increase in highway transportation of explosives and dangerous articles, including gasoline.

No recent hearings were held on applying these regulations to private carriers and hauling within a state. ICC officials said that question of extending these rules was covered in hearings held several years ago at Washington, Los Angeles and Tulsa.

Oil companies, contacted by NPN, point out that applying the equipment rules to private trucks may require more time by mechanics and electricians than is available for ordinary repairs to keep trucks rolling. Also, they question if copper wire, conduits, and other critical materials are available.

Would Slow Deliveries

Applying the operating rules to bulk plant trucks—such as logging every stop, time between stops, and other data on each delivery on a route—will seriously slow down deliveries to farmers.

Truckers, who have been complying with these rules in their interstate operations, say it requires several months to familiarize drivers with keeping records.

ICC officials said that the rules were broad enough to cover any and all trucks hauling gasoline and other inflammable liquids in bulk. They expect that ICC may be asked to exempt some types of trucks but they wouldn't predict what the commission would do when and if such requests are received.

East Faces Long 'Gas' Famine

Ickes, in Radio Talk, Hints Further 'Gas' Cuts in Mid-West. PAW, ODT, OPA Institute Emergency Measures to Increase Products Flow

WASHINGTON — PAW Ickes seems to be preparing the Mid-West for further cuts in gasoline rations so that more transportation will be available to bring gasoline to the East, now in its second week of "famine"—and without any definite signs of improvement.

In a nationwide radio talk June 1, Mr. Ickes said although effects of the shortage have been felt only in the East—so far—there is no assurance that they may not spread inland. "For if we can bring in additional gasoline from other parts of the country to relieve the situation here," he said, "that is what we are going to do."

Mr. Ickes put the problem directly up to the people, saying:

"The extent to which we can stretch our gasoline depends entirely upon you. You know and I know that there isn't anybody—a ration board, a government agency, or even your closest friend—who can judge how far you can cut your use of it. Only your conscience can decide that . . ."

The administrator's talk came in the midst of emergency measures taken by OPA, PAW and ODT to relieve the crisis.

Cut 'B', 'C' Coupons in East

Most important was OPA's cut of "B" and "C" rations in the 12 northeastern states, eastern 8 counties of West Virginia, and District of Columbia, from 3 gal. to 2.5 gal. per coupon. Action was taken June 2 by OPA Chief Brown who said necessary amendments would be made later to the regulations to cover it.

Ration boards were instructed to deny applications for additional rations to restore mileage lost by the new cut; to revoke present provisions allowing special rations up to 5 gal. to furloughed service men; to deny supplemental rations to applicants living within reasonable walking distance of work regardless of car-sharing and lack of other transportation. Only exceptions will be for the physically disabled and for carrying heavy equipment, such as tools.

Cut Doesn't Affect Southeast

Mr. Brown said the cut would not be made in the Carolinas, Georgia or Florida, "pending investigation" of gasoline supplies there by PAW.

Simultaneously, Mr. Ickes certified to OPA that only 326,000 b/d of gasoline—instead of the 356,000 b/d certified May 15—would be available for the East this month.

On May 27, ODT, fearing that its "T" ration stretch-out action would not do the job of a 40% cut, ordered all northeastern bus and taxicab operators to cut mileage immediately by 20%. This was backed up by General Order ODT No. 39.

To relieve the Washington-Baltimore area—the worst hit in the East—ODT had rounded up over 100 transport trucks during the first part of last week, to haul gasoline off the Plantation pipeline at Greensboro. But it was not until May 28 that PAW made arrangements to start the movement. In the meantime, operators of these trucks, which were idle, were worrying about how they would hold their drivers.

Won't Help 'Average' Man

PAW emphasized on May 28 that this movement wouldn't mean much relief for the average motorist in the area. The gasoline would be available only for essential requirements—farmers, services maintaining essential public transportation, and minimum needs of war workers. PAW expected only one week's operation would drain off all the supplies available for truck movement from Greensboro.

On June 2, ODT reported there were 135 trucks in this service and as of 6 a. m., 168 truckloads had left Greensboro. Arrangements were under way to allow the trucks to exceed the 35 m.p.h. speed limit by having them fly "V" pennants.

In a further effort to keep essential motor vehicles moving, ODT on May 31 established a priority system for the shortage area, based on a list of essential services certified to ODT by WPB, which will be used in granting supplemental gasoline allotments to commercial motor vehicles in the area. Additional gasoline will be alloted, ODT said, only for essential commercial services which could not be continued under the 40% mileage cut demanded by ODT last week.

Many Continue All Year

Except for operators entitled to supplemental gasoline rations under this priority system, the 40% mileage cut, ODT added, "will probably be continued for the rest of the year in the shortage area."

Under the priority system, an operator may request supplemental gasoline on the grounds of severe hardship but will be required to support his contention fully with records of operations.

WPB emphasized that the priorities list certified to ODT was held to "strict limits of essentiality" so as to assure that industries most necessary to the war effort would not be hindered by lack of transportation during the crisis.

To obtain a supplemental allotment under the priority system, an operator must be:

1—A property carrier hauling supplies for the Army, Navy, Maritime Commission, or Lend-Lease for export.

2—A passenger carrier rendering vital pub-

lic transportation service.

3—A property carrier serving the basic operations of an essential industry, as defined by WPB.

4—A passenger or property carrier who can prove that services necessary to the war effort or the essential civilian economy would be unduly restricted without additional gasoline.

Simultaneously, to help doctors and ambulances get gasoline, OPA announced an emergency procedure under which OPA district directors can designate service stations or facilities which will give preference in sales of gasoline for services essential to public health and safety in localities where gasoline shortages develop.

Any stations so designated will be required to sell gasoline without discrimination among ration holders. But, OPA added, this does not bar them from limiting the number of gallons sold to each customer, if short supplies make it advisable to do so, provided all customers are treated alike. Provisions for necessary exceptions to present "non-discrimination" requirements, OPA said, will be made in an amendment to the gasoline rationing regulations.

At the same time, on May 21, PAW announced 2 actions to help alleviate the Eastern crisis.

Zone District 3 Supply

One, PAW Directive 67, calls for a complete rearrangement of gasoline distribution and supply in the Southwest—District 3. Specific objectives of the order are: eliminate cross-hauling or back-hauling; eliminate or shorten movement within District 3 by barge, tank car or transport truck wherever possible without loss of transportation efficiency; substitute, where possible, pipeline movement for barge, tank car or truck movement, etc. (*See full text of order on p.* 11).

In the second emergency measure, PAW authorized tank car movement to the East Coast of gasoline delivered to West Virginia and western Pennsylvania river ports by barge from the Southwest to enable quick movement to the sections of greatest shortage. Previously, transhipment eastward from these points was allowed by pipeline only. Action was taken in amendment to PAO No. 7.

Meanwhile, on May 27, American Automobile Assn. asked the President to appoint a national committee, headed by Bernard Baruch, to straighten out the "muddled" petroleum situation the same way a blueprint was drafted on rubber.

The next day, Eastern States Gasoline Dealers Conference here termed the crisis "entirely uncalled for" and urged an L-70 type of quota system be placed over OPA's coupon system.

Atlantic seaboard congressmen are planning a full investigation of the situation. Rep. Hartley, N. J., has called a meeting of all northeastern senators and representatives for June 5 at 10 a.m.

None of the government agencies on June 1 would venture an estimate as to future oil receipts in District 1, but ODT pointed out that the previous high level of shipments overland can't be reached again until flood-affected pipelines, railroad bridges and roadbeds have been repaired and water receded to permit normal barge movements.

CHICAGO OIL ROUNDUP

:: *News and Gossip in the Mid-West* ::

By EARL LAMM, NPN Staff Writer

CHICAGO—PAW has authorized an increase of 50,000 b/d in crude oil runs to refineries in District 2, making somewhat happier the refiners who were shorted by the allocations order of May 8 (*See NPN May* 12, *p.* 16). This brings total allocations to 1,150,000 b/d for the district, and is said to correspond more closely with new figures on field production arrived at by the industry's District 2 subcommittee on statistics and economics.

A.P.I. production figures for the week ending May 22 totaled only 1,048,000 b/d for the district, and more than likely the new allocations order merely constitutes a "hunting license" for more crude in an effort to keep refiners from drawing too heavily on storage. The regular set of production figures used by the S & D subcommittee, however, differ from those of A.P.I.—in this case, 102,000 b/d apparently, which represent a "sifting of the producing sand" to recover the last daily drops.

District 2 refineries located west of the Mississippi also have been authorized to increase once more their yields of gasoline. War products plants go to 100% of normal and others to 90% of normal. Period from July 1, 1941, to Dec. 31, 1942, has been called "normal".

But some loose strings are attached to the new order. Provision is that the increased yields will be effective only if it will not increase gasoline stocks, will not require additional tank cars to move it, and will not reduce production of critical war products.

In other words, refiners west of the Mississippi in District 2 can go to 90% of normal gasoline yield if the additional material can be distributed by tank truck for local consumption, and can be handled by barge or products pipeline. Primarily, the increase is intended to quiet the cries for more gasoline in Kansas and Oklahoma where the shortage is most critical.

Refineries east of the Mississippi and north of the Ohio rivers have been instructed to ship all possible products, including gasoline, to District 1 to help relieve the shortage there. Permits for tank car shipments of gasoline, heretofore difficult to obtain, are now reported easy to get.

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A manpower subcommittee of the District 2 marketing committee has been appointed to facilitate handling of help problems in that branch of the industry in the Mid-West.

"Membership of this subcommittee includes men from the widest possible cross-section of the marketing branch in this area," B. L. Majewski, chairman of the District 2 marketing committee, declared in announcing the list of names and companies. They are:

H. T. Ashton, chairman, St. Louis, Socony-Vacuum; R. W. McDowell, vice-chairman, Tulsa, Mid-Continent Petroleum Corp.; Joseph L. Nolan, St. Paul, Farmers Union Central Exchange; E. J. Webster, Bartlesville, Okla., Phillips Petroleum Co.; Phil T. Williams, Indianapolis, Gaseteria; N. C. Beim, Minneapolis, W. H. Barber & Co.; Paul Kempf, Ann Arbor, Mich., Staebler-Kempf Oil Co.; A. A. Stambaugh, Cleveland, Standard of Ohio; and A. H. Pass, Chicago, Standard of Indiana.

Study and full consideration of manpower problems will be given by this subcommittee, Mr. Majewski said, in order that PAW and WMC will have a clear picture upon which to base policy decisions.

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Disruption of traffic incident to floods in the Mid-West has caused PAW, District 2, to approve more exceptions for tank car shipments of products into the area under Directive 65—zoning supply and distribution—than otherwise would have been okayed, according to a PAW spokesman.

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Oil Heat Institute of America has called a meeting for June 17-18 at the Blackstone hotel in Chicago to form the "strong national organization" of fuel oil distributors and oil burner manufacturers that was proposed some time ago.

Presidents and secretaries of various local, sectional and regional associations are scheduled to attend the meeting and form a council to affiliate with the Oil Heat Institute. Council officers and various working committees are to be elected in order that a definite program may be developed and aggressively pushed.

Original date announced for the meeting was June 24-25.

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"T" coupons totaling 12,000,000 gal. of gasoline issued for use in the Chicago area have been recalled to date as the result of a survey among truck operators conducted by the regional office of ODT, according to Thomas A. Snyder, assistant regional ODT manager. The survey, which started 30 days ago, is a check on cases where gasoline allowance of truck operators is believed to be in excess of actual need.

The excess gallonage coupons picked up to date have been called a mere drop in the bucket by some who indicate that there is a considerable unethical traffic in "T" coupons. The survey continues, however, and additional coupons are being recalled.

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An unusual announcement last week was that by Edward G. Seubert, president of Indiana Standard, who said that "Red Crown" stations re-opened in April outnumbered those which closed their doors. This wasn't due to relaxation of rationing by any chance—merely spring fever attacking station operators in "defrosted" northern sections of the company's territory.

Thompson Again Warns Of Crude Shortage

Special to NPN

AUSTIN—Col. Ernest O. Thompson, member of the Texas Railroad Commission and one of the world's authorities on oil, has issued the stern warning that the U. S. faces a serious shortage of oil and gasoline unless something is done to encourage wildcat drilling.

"We have drilled 307 dry wildcat wells in Texas this year," he declared. "Only 23 struck oil."

"Unless some action is taken promptly on oil prices there is going to be a worse shortage of oil than there was of rubber. We are going to have rubber and still find ourselves afoot because of the delay in Washington on oil prices."

Col. Thompson quoted reports that shortages have even become apparent in the Mid-Continent areas of Oklahoma and north to Chicago, and said the Army's requirements more than offset the effects of rationing.

Urges Near-Capacity Runs

"This is bound to lead to further shortages unless PAW permits refineries to run more nearly to capacity than is now allowed, which is 78% of capacity."

Using figures put out by the OWI, Col. Thompson showed that the combined output for one day of all the oil wells in Texas would be required to keep 100,000 military airplanes in the air for a single hour.

The OWI figures that a single airplane motor in one hour will burn 50 gal. of high-octane fuel. Col. Thompson said he estimated, "conservatively," that 4 bbls. of crude would be required to produce 50 gal. of aviation fuel, or around 20 bbls. of crude for a 4-motored craft.

Since the average output per well of Texas' 100,000 oil wells is 14 bbls. daily, Col. Thompson said the combined daily production would just about keep 100,000 planes in the air for an hour.

"The enormity of the demand for aviation gasoline is staggering," he stated.

Demands OPA Relieve Price Inequalities

NPN News Bureau

CLEVELAND—President Roosevelt's "freeze order" of April 8th has frozen all price inequalities in the oil industry, according to OPA's report to Congressman Carl E. Mundt, of South Dakota.

Congressman Mundt reported to Secretary Adrian of the South Dakota Independent Oil Men's Assn. that according to O. D. Judd, of the OPA petroleum branch, OPA is hopeful of a change in the freeze order which will permit them to do something about price inequalities.

Secretary Adrian, in appealing to Congressman Mundt, points out that the gasoline ceiling price in the town of Menno was 15c and that the Standard Oil Co. felt obliged therefore to reduce its price on third grade gasoline in nearby Scotland, S. D., from 16.6 to 15c. The jobber at Menno has no other market in which to recoup his losses from the unprofitable 15c price. Secretary Adrian argues that OPA should set price ceilings over areas and disregard any low prices therein due to local price wars.

Said Secretary Adrian to Congressman Mundt: "The present system of freezing petroleum prices allows people in localities where petroleum price wars existed at the time prices were frozen, to be able to continue to purchase petroleum at a very low price, while the people in other communities where normal and even prices above normal were frozen, are paying as much as 4c a gallon more.

"It is my contention that if OPA would freeze a price on petroleum products as, for example, the necessary price shown for South Dakota, for every point in the state of South Dakota and for that matter throughout the nation, then this would be the maximum ceiling price. If a jobber chooses to sell for less than the ceiling price, he would have no one else to blame but himself.

"It might be wise and I believe that it would be, that a floor should also be placed on prices so as to give protection to the independent against ruinous price-cuts which might occur and which in many cases are started for the sole purpose of running some independent out of business."

Indiana Standard Plans Production Boost; Urges Price Advance

NPN News Bureau

CHICAGO—Standard of Indiana and subsidiary (Stanolind) are in the market for additional proven or producing properties, and now have on an extensive development program of their own, E. G. Seubert, president, said at his annual press conference here May 27.

The press conference was held at the company's Chicago office just prior to the meeting of stockholders at the Whiting, Ind., refinery, at which time all encumbent directors and officers were re-elected.

Supplies of heavy fuel oil and kerosine are short in the Mid-West, Mr. Seubert declared, adding that "gasoline is a little short." Distillate supply was described as good, and improvement in supplies of other products is largely dependent upon getting more crude.

He doubted if a deeper cut in gasoline consumption by ration tightening would be needed. "Things look better," he said, "as there likely will be more rubber." Crude oil, he hoped, would be put on a normal supply and demand basis, but a great deal depends on military requirements.

Refinery Capacity Ample

Refineries will be able to furnish enough aviation gasoline for our war needs and can also supply large quantities to Britain, Russia and other allies, in his opinion.

Proposition for construction of the Stanolind Pipe Line Co.'s 16-in. line from West Texas to Drumright, Okla., a distance of 383 miles, is now in the lap of the Petroleum Administrator for War, with the company awaiting approval, he said. The line, if built, would handle both sweet and sour crudes from the Permian basin. He explained that some wells in that area produced sweet crude while others produced sour crude.

Indiana Standard now either owns or controls 47% of its gross production, the net figure being given as 41%, with both percentages on the increase.

Answering a question on the present price of crude oil, he declared that a 25c to 35c per bbl. increase was needed and that it would stimulate drilling. "There should be a proportionate increase in product prices, also," he said.

Sees Earnings Equal '42

Estimated earnings of the company for the first quarter of this year are "a little below" last year, but considering that the comparison is with a period prior to gasoline rationing, it was felt this year would end up with earnings about the same as 1942.

Overall retail gasoline sales are off about 5% and total sales of all products, off 1%. These figures include sales by all companies, Mr. Seubert explained. The tide has turned in operation of service stations, as more stations are now opening than are closing. This, it was explained, is partly seasonal as it has always been customary for a number of stations in the colder portions of company's trade territory to close during winter months.

Application of the 48-hr. week to the Whiting, Ind., area has eased somewhat the manpower shortage there, "but today we could put 400 more men to work if we had them."

'American-Made Rubber Day' Proclaimed in Texas

Special to NPN

AUSTIN—Gov. Coke Stevenson of Texas has proclaimed June 28 as "American-Made Rubber Day" in this state and ceremonies will be held at Houston and Baytown, where the government-owned synthetic rubber plant to be operated by General Tire and Rubber Co. is scheduled to get under way. Harry C. Weiss, president of Humble, which is to supply butadiene for the Baytown polymerization plant, will participate. Invited to take active part in the celebration are Secretary of Commerce Jones; Rubber Director Jeffers; and Senators Tom Connally and W. Lee O'Daniel. A nationwide broadcast will pay tribute to Texas for its part in the solution of the U. S. rubber problem.

Oil-Heat Institute Appoints Postwar Planning Group

Special to NPN

BOSTON—C. E. Lewis, president of the Oil-Heat Institute of America, has appointed a committee of postwar planners to take under advisement the major issues that will have to be considered and dealt with when the oil and heat industries again resume their normal course of activity.

The Advisory and Postwar Planning Committee is headed by W. A. Matheson, Oil-O-Matic. Members are W. F. Brannan, Anchor Post; Hugh Courteol, Mercoid; Alexis Doster, Torrington; E. A. Halbleib, Delco; W. A. Kemp, Sunstrand Machine; S. A. Loeb, Webster; J. K. Luthe, Perfex; J. H. O'Brien, Petro; Albert Penn, Penn; J. P. Rainbault, General Electric; W. F. Rockwell, Timken; R. M. Sherman, Silent Glow; Harold W. Sweatt, Minneapolis-Honeywell; and G. B. Tuthill, Tuthill Pump.

NPN Reports

War Oil News and War Orders from

WASHINGTON

For ALL branches of the Oil Industry

WASHINGTON BUREAU, 1034-36-38 National Press Bldg. ● Telephone National 3477 ● A. M. PETTY, News Editor and Chief of Staff

Distribution Manpower:

Essential on a 'Local Basis'?

PAW Prepares Blueprint of Plan Aimed at Maintaining Needed Manpower in Bulk Plant Distribution. WMC Feels Few are 'Irreplaceable'

By A. M. Petty
NPN News Editor

WASHINGTON—PAW is blueprinting a plan to provide the necessary personnel for "locally needed" oil distribution facilities, based on minimum amount of manpower and maximum use of equipment.

PAW's program, so far, applies only to bulk plant distribution, not service stations. It aims only at maintaining the manpower needed, protecting against "raids" by war plants and other "essential" industries. But it may also be helpful in individual cases in obtaining draft deferments for irreplaceable men "locally needed" to keep the approved distribution plan operating.

War Manpower Commission has declared oil production, refining and transportation to be "essential" on a national basis. Oil distribution has not been classed as "essential" either on a national or local basis. WMC feels that there is much overlapping in all types of distribution, that few men in distribution activities are irreplaceable.

Necessary, But On Local Basis

WMC admits that distribution of a necessary commodity—such as petroleum products—is vital to the war effort. But WMC officials feel that this function can be performed with fewer facilities than now operating, that most of the jobs can be handled by women, boys or old men unfit for war plant work. Until distribution facilities have been pared down to what WMC regards as bedrock, with all replaceable men released, this function cannot be put into the "essential" category. Obviously, it will be a long time, if ever during the war, before distribution in all areas will reach such a state. That's why WMC continues steadfast in its refusal to put oil distribution in the "essential" category on a nationwide basis.

But the manpower commission is willing to class oil distribution as "essential" on a "locally-needed" basis. When facilities and personnel have been reduced to a point where, if it went any further, the minimum essential needs of the community could not be met, then WMC is prepared to say that what remains is "locally needed".

That places upon oil marketers in an area the burden of proving that they, as a group, are using the minimum manpower required to provide "locally-needed" service with the maximum utilization of equipment. This may require joint use of facilities where such a program would result in savings on manpower and equipment required.

If marketers, as a group, can make out such a case, then the regional WMC office will declare that the facilities and men involved in the program are "essential" on a "locally-needed" basis.

PAW has worked out a tentative set of standards for determining the bedrock program, that is, the "locally needed" minimum. These are now being tested in "pilot" surveys at Evansville, Ind., and Dayton, Ohio. Other "pilot" studies are getting under way in areas around Portland, Me.; Hartford, Conn.; Baltimore, Md.; Charleston, S. C., and Beaumont-Port Arthur-Orange, Texas. These areas are among the 42 in the U. S. which WMC has listed as acute labor shortage areas. Also, these areas chosen by PAW for "pilot" studies are spotted among 6 of WMC's 12 regions.

Other studies will be made in acute areas in WMC's other regions. Thus, a pattern satisfactory to each WMC regional office will be worked out. This is important because the whole matter is being handled on a regional rather than national basis.

'Essential' Categories Explained

For draft deferment and manpower utilization purposes, WMC has three categories of industrial and business activities—essential, less essential and non-essential. It is important that these three categories, with their rights, obligations and liabilities, be clearly understood. These classifications figure prominently in PAW's plans for obtaining consideration of oil distribution on a "locally needed" basis.

In the "essential" category, the manpower commission has listed 35 industries. These are war industries or activities necessary to support of the war effort. Next to the armed forces, these industries have first call on the nation's available manpower. In some cases, these industries supposedly outrank the armed forces in their claim to an individual man's services. Approximately 2000 occupations in these 35 industries have been listed as "essential" which means that local draft boards may defer induction of men between 18 and 38 holding such jobs. These "essential" men in "essential" industries, if granted deferments, are placed in one or the other of the following groups: 2-A, a war-supporting industry; 2-B, a war plant; and 2-C, agriculture. Employes in these "essential" industries are supposedly safe from "raids" by other industries. In fact, transfers from one plant or industry to another even for higher pay is prohibited, except in a few limited cases. Oil production, transportation and refining have been classed as "essential" and a number of jobs in these three branches have been designated as "essential occupations" (See Selective Service, A.O.B. 23, 26 and 35).

No Oil Jobs Are 'Non-Deferrable'

In the "non-essential" category, WMC has listed 34 occupations such as bartender, boot black, dancing teacher, night club manager, soda dispenser, etc. Also, a number of activities such as costume jewelry, turkish baths, art studios and the like are listed. Closest any of these come to the oil industry is parking lots. These have been specifically designated as "non-deferrable" occupations. Holders of these jobs were given 30 days to find war work or face induction into military service regardless of how many dependents they have. Presumably, all such men who didn't change jobs have been called up by now and either have been inducted or rejected as 4-F.

When first announced on Feb. 3, 1943, it was indicated that this "non-deferrable" list would be added to from time to time. It was hinted that this was to be the means of forcing men into war plants from less essential jobs. Even the hints had their effect, causing a stampede from essential as well as non-essential civilian work to war plants. But no additions to the list have been made and indications are that WMC has no present intentions of going ahead with this policy.

"Less essential" is the category into which fall all other activities, not specifically classed as "essential" or "non-essential." Oil distribution is in this "less essential" category.

These "less essential" activities are the hunting ground for U.S. Employment Service offices seeking recruits for war plants and other "essential" industries. The USES offices in each state are constantly checking over the occupational questionnaires of men between 18 and 65 in the "less essential" industries. When they find a man whom they think is qualified or can be trained for war plant work, they write him a letter suggesting that he transfer to such work. The employment office may also certify his name to a nearby war plant personnel officer who will contact the prospect.

While considerable pressure can be exerted, aside from the lure of higher wage rates and plenty of overtime, there is no legal obligation

at present for the man in "less essential" work to transfer, except in the case of a man with farm experience.

Offsetting the lure of higher wages is the fact that, if the man stays with his present employer—say a bulk plant or station operator—and is drafted, he is assured of a job after the war when demobilized. Selective law requires an employer to hold a job for each employe inducted into military service.

There is no such requirement when an employe leaves to take a war plant or other non-military job. And the war plant cannot guarantee the transferring worker a postwar job because more than likely it will be closed down when peace comes.

Farmers Get 'Hunting Licenses'

But there is an "open season" on all men with farm experience, even those above 45, who are not now engaged in agriculture or some "essential" industry or in uniform. The farmers—or rather their representatives, the County War Board in each county—are hunting farm manpower with "loaded guns".

Local draft boards have been advised (LBM 164-C) to submit lists of such men with farm training or experience to the County War Boards. Such lists include even the 4-Fs as well as men over 45. The county boards send a form letter to these men, threatening them with induction into military service unless they return to farm work.

Some overzealous war boards are not limiting these letters to farm-experienced men in "less essential" industries. For example, some pumpers and other production employes have received such "threatening" letters even though the production branch of the oil industry has been classed as "essential" and therefore is supposedly immune from raids by other industries.

Even farmers working part-time at bulk plants or service stations or other "less essential" work are being eyed by the county boards. They are "threatened" with loss of their 2-C (agriculture) deferment unless they go to farm work full time.

Lube Engineers Are 'Essential'

While oil distribution itself has not been classed as "essential", there are jobs in oil distribution which are classed as "essential occupations" under some other category.

For example, PAW is advising oil companies that their lubrication engineers come within the category of "petroleum engineer" and are therefore eligible for draft deferment under Selective Service's bulletin, A.O.B. 35. Such engineers should be technically qualified but it is not necessary that they be college graduates, nor have any formal engineering schooling. A lubrication specialist with 20 years' experience might be far better qualified to advise plant managers or farmers on lubrication requirements of their machinery than a graduate engineer.

Another instance is an oil terminal which comes under the "essential" classification given to oil transportation. "Necessary" or irreplaceable men at such terminals are deferrable. Also, all employes at such terminals are protected against "raids" by other "essential" industries.

It is difficult to define "terminal" so that it will fit all cases. It cannot be on a gallonage basis because there are many bulk plants larger than some terminals. Inclination is to regard a "terminal" as any bulk station from which deliveries are made to other bulk stations, with some other conditions perhaps. PAW is now working out with WMC a definition of "terminal".

Some Stations Have 'Deferrables'

Service stations are considerably farther down the essential list than bulk plants in WMC's estimation. Yet there are some activities at some larger stations which may come within the "essential activity" list in Selective Service's bulletin, A.O.B. 31. This is more likely true of stations run in connection with an automobile dealership, tire repair shop or garage.

Activity and Occupation Bulletin No. 31 includes among its "essential activities": Armature rewinding service, automobile, bus and truck repairs; bicycle repairs; tire recapping; tire vulcanizing and repairs; welding; and machine shop services.

"Essential" occupations in these activities include: Automotive-body repairman; automotive electrician; foreman; automotive mechanic; motorcycle mechanic; machinist; tire retread moldman; and tire section repairman.

A note appended to the job of foreman reads: "This title covers foremen who are engaged in supervising duties in connection with repair services as described above for this activity. It includes individuals who exercise independent judgment and assume extensive responsibility for repair services. It does not include foreman of common labor."

Oil-burner repair services and oil-burner-installation serviceman are also listed in A.O.B. 31.

As regards activities and occupations listed in Bulletin 31, Selective Service headquarters at Washington suggests that local draft boards consider the men holding these jobs as eligible for occupational deferment "only to the extent and in such numbers as may be required to meet the minimum essential needs of the community."

File With Draft Boards Now

Operators of establishments offering services classed as "essential" under A.O.B. 31 should file deferment application immediately on men in the eligible occupations. For single men and childless married men between 18 and 38, Form 42 or Form 42-A should be used. These forms are obtainable from local draft boards. File a Form 42-B application on all married men with children who are in the eligible occupations. This assures the employer 15 days notice of the draft board's intent to reclassify the employe and gives him a chance to work up a presentation, should he decide to seek the man's deferment.

No matter how discouraging is the outlook nationally on Washington officials classifying oil distribution as "essential", oil marketers should bear in mind that Selective Service is handled on a local basis by local boards familiar with local conditions. These boards have wide discretionary powers.

Local boards may disregard any "suggestions" from Washington (except the present injunction against drafting fathers). They have authority to set their own standards of essentiality according to local situation. Thus, if a local board considers that a bulk plant or service station employe is "essential", then the board can defer his induction even though he does not come within any category of essentiality issued from Washington. For example, local boards might be more amenable than Washington authorities were to the suggestion that it requires considerable time to train a man at a bulk plant in the handling of inflammables.

PAW Prepares Blueprints

WMC's willingness to consider oil distribution on a "locally needed" basis has prompted PAW to work on a pattern that can be used by groups of marketers in labor shortage areas to get the stamp of "essential" on their joint programs. Without this designation, they face the loss of not only their physically fit men to the draft but their 4-F, over-age, physically-handicapped and other replacement personnel.

PAW's pattern for obtaining the "locally needed" designation includes compliance with certain standards. A tentative list of these standards is being tried out in the 9 "pilot" studies being made in Districts 1, 2 and 3 and soon to be made in Districts 4 and 5. These standards will determine which facilities and how much manpower is "locally needed" to maintain effective distribution of petroleum products for essential purposes.

The standards include provisions from ODT General Order No. 37 on local deliveries (no call backs, minimum dumps, etc. See NPN, May 12, p. 14), adherence to 48-hour week and—so far as is practicable—joint use of facilities and exchanges of products to reduce equipment of manpower needed.

D.J. Gives 'Green Light'

PAW has obtained Department of Justice approval for a new Directive No. 68 which will give specific clearance to local joint use programs. This "green light" is in addition to general authority previously granted by Deputy PAW Davies and other PAW directives.

PAW's district marketing committees are well-informed on steps required to obtain a "locally needed" designation for an area plan. Marketers should get in touch with their district committees at once, if the labor situation in their area makes this advisable.

PAW does not intend that this plan will be applied in all areas. There will be some areas

where the labor shortage is not acute, so there would be no need for such a joint use program.

In other areas, the acute stage was reached long ago. Bulk plants and stations may have been closed to such an extent that distribution is now down to bedrock, with a breakdown threatened by continued draining of manpower.

In these acute cases, it might be found that very little change was needed in order to show maximum use of facilities and minimum manpower, in order to qualify the "locally needed" designation.

Even service stations could be designated as "locally needed" if a situation existed where queues of cars waited their turn at the pump island, not because of gasoline supply shortage but because of mortality among stations.

Results Achieved by Plan

When oil distribution facilities in an area have been designated by the regional manpower office as "essential" on a "locally needed" basis, here is what results:

U. S. Employment Offices will stop "raiding" the distributors' employes for war industries. Instead, USES will help recruit the personnel necessary to maintain the standards of distribution provided for in the approved plan. In other words, the oil companies are put on the same basis as a war plant so far as their operations in that area are concerned.

Employes, under national and area stabilization programs, will be forbidden to transfer to war plants or other "essential" industries even for higher pay (except in a few limited cases).

Bulk plant operators and other employers under the "locally needed" plan will have a better case to get draft deferments for their "essential" men. Also, oil companies will have a better chance of getting replacement schedules approved for their distribution employes classed as "locally needed".

This is the fourth in a series of weekly NPN articles on manpower and draft deferment policies. Another will appear in next issue of NPN—Ed.

Capital's Pleasure Cruisers Can't Ply Potomac Now

WASHINGTON—Motorists have learned what "pleasure driving" means—or the lack of it—and now it's the excursion boat's turn to feel the pinch. At any event, this city's landlubber population won't be going to sea this summer unless the local OPA reconsiders its refusal to grant fuel coupons to the pleasure boats that ply the Potomac. One streamliner—the steamer Mount Wilson—was to have shoved off for its initial trip more than a week ago but was unable to because of the OPA decision. The Mount Vernon uses about 60,000 bbls of oil each season and accommodates about 2450 persons per trip. Two other steamship companies, the Potomac River Line and the Robert E. Lee Steamship Co., likewise are unable to get oil.

Washington Outlook . . .

Background News and Opinion

By A. M. PETTY, NPN News Editor

PAW's equipment redistribution plan has again reared its bloody-but-unbowed head.

Automatically it comes to attention of the higher-ups once a month now. That's because P-98-b and P-98-c both contain a deadline for complying with PAW Redistribution Plan No. 2. When end of the month rolls around and The Plan has not been issued, these two priorities orders must be amended again to set a new deadline. The deadline was May 31. Next time it may be June 30. Soon it may be a race to get The Plan out before anniversary of its predecessor, the late, unlamented Huff Plan, which was absorted in mid-summer last year.

Currently, PAW's redistribution plan bears little resemblance to The Huff Plan. Inventory reporting is limited to surplus critical materials only (the first plan was to list *all* items of $10 and over). Definition of "surplus" is somewhat elastic but generally conforms to stocks in excess of 90-days' requirements.

When presented to Deputy PAW Davies, the redistribution plan ran 30-odd pages. He tossed it back with instructions to cut it to not more than 6 pages. On the first try, it was pared to 6¼ pages (not counting the appendices). The pruning knife had been applied again.

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OWI was a trifle overzealous in its anxiety to blame the eastern gasoline famine on the North African military campaign.

Without bothering to check its facts with PAW first, as required by OWI's own rules, OWI issued a press release saying that General Doolittle's flyers in Tunisia had used more gasoline in a 15-day period than eastern civilians had. That was startling news. It indicated that the oil industry has a military demand to fill far greater than anyone imagined.

Only trouble was that the OWI writer took the *daily* gasoline supply figure for the East Coast and used it as a *monthly* demand in comparing it with the Tunisian plane consumption. Thus, he reduced eastern civilian demand to less than one-thirtieth of what it actually was. It made good newspaper reading. It made the gasoline-less motorist feel patriotic. And isn't that the function of propaganda in wartime?

° ° °

Don't overlook potentialities of the latest White House drive to force greater employment of Negroes, placing them in jobs and industries where they never were before.

Here are some authoritative figures which may throw some light on what's to come:

On April 30, approximately 3,000,000 Negroes between 18 and 38 were registered for the draft. Of these, 17.8% were in the armed forces; 18.1% had been classed as 4-F (that is, physically, mentally or morally unfit for military service).

On same date, about 26,200,000 white men in same age group were registered. Of these 26.2% were in uniform; 8.7% had been classed 4-F.

Roughly speaking, that means the draft boards had had to call up more than two Negroes to get one fitted for military service. (The 4-F ratio was much higher among city Negroes, lower in rural areas.) In contrast, less than 7 white men needed to be called to get more than 5 fit for service.

If military authorities stick to their goal of 11,000,000 men in uniform by end of 1943, it would seem that more and more whites will have to be taken in to make up for higher percentage of Negroes rejected as unfit. (A large part of the 4-F Negroes were rejected because of venereal disease.)

Most of the Negro 4-Fs, however, are not unfitted for war plant or civilian jobs. So the proportion of Negroes available for employment will increase. At same time, draft boards will cut deeper and deeper into occupationally-deferred white men in order to meet their quotas for military service. Thus, the white worker is caught in a spiral, especially in cities where the percentage of 4-Fs among Negroes is higher.

With white manpower depleted and Negroes relatively more available, the Roosevelt Administration will have some cold, hard figures to implement its drive for more Negro employment.

President Roosevelt, by executive order (No. 9346) on May 28, set up a new Committee on Fair Employment Practice. He abolished the old committee which was under WMC McNutt. New committee is connected directly with the White House itself. Chairman is Monsignor Francis J. Haas, a Catholic priest who was a member of NRA's labor board and has been prominent in New Deal labor activities since then.

New order requires all government agencies to include in all contracts hereafter negotiated or renegotiated by them a provision "obligating the contractor not to discriminate against any employee or applicant for employment because of race, creed, color, or national origin and requiring him to include a similar provision in all subcontracts." Inclusion of subcontractors extends the coverage of this order to thousands of employers. Indeed, in a wartime economy nearly every employer is dealing with some firm which holds a government contract. The committee is authorized to "take appropriate steps" to eliminate "discrimination."

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Reading the price control law the other day, an oil man was overjoyed to find that OPA was supposed to die automatically on June 30,

1943. He was heartbroken when told that OPA had been given a reprieve until June 30, 1944, by a provision in the economic stabilization law passed last October. But that June 30 death sentence on OPA may have been prophetic.

Few people around Washington expect OPA, as such, to continue much longer. One idea is that it will be converted into an advisory agency under the economic stabilization board, on which Judge Fred B. Vinson, Ashland, Ky., succeeded Justice Byrnes as chairman. Food Czar Davis, PAW Ickes and other agencies would make recommendations on price to the economic stabilizer who would call upon what-used-to-be-OPA for analysis. (It's an old trick of FDR's to change the dress of an agency when it becomes too splattered.)

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OPA's oil unit has a "green light" now to resume "spelling out" tank wagon prices in local marketing areas after having "held the line" since April 8. These "spell outs" may open the door for OPA to advance tank wagon prices in subnormal areas caught in the freeze of Octber, 1941. Some independent jobbers have the impression that action on subnormal tank wagon prices was promised to them some months ago.

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Odds and Ends—PAW Ickes has "reluctantly" requested Department of Justice not to file that cracking patent case until after the war—but it may get an airing anyway on Capitol Hill . . . . PAW is thinking of a superplanning agency, a Programming Committee that would steer supply trends for two years in advance . . . . Sen. Eastland, Miss., wants it known that he had a hand in getting OPA to up the Tinsley crude oil price . . . . Few people outside of PAW realize how close Georgia and Florida came to be washed out of the eastern shortage area . . . . Complaints about PAW Directive 65 (mid-western zoning) are beginning to trickle into the justice department's antitrust division . . . . Columnist Walter Lippman has joined those of us who believe that PAW Ickes will fall heir to control of oil rationing and oil prices . . . .

Oklahoman Queries Hull On Deal With Mexico

WASHINGTON—Congress and the American people are entitled to know the facts behind a printed report that Mexico has been granted priorities on $50,000,000 worth of oil well drilling equipment, Rep. Jed Johnson, Okla., asserted May 31 in calling on the State Department for an explanation. The issue will be taken up on the floor of the House if no answer is forthcoming in a reasonable time, Mr. Johnson said.

In his letter to Secretary of State Hull, the Oklahoma representative said he was "amazed and actually shocked" to learn that Mexico was to receive oil equipment that was being denied to American producers.

He said he had received many letters from oil operators and producers, especially wildcatters, saying that they had been unable to obtain priorities for needed equipment and asking why, when the government is urging the opening of new American oil fields by wildcatting for new production and the development of production already discovered, they are unable to satisfy their needs.

He asked if such a deal as the purported Mexican transaction were actually in the making and promised further action.

March, Gasoline Demand 16% Below 1942

WASHINGTON—Total March demand for motor fuel was about 45,000,000 bbls., 16% less than a year ago, Bureau of Mines reported May 26. Gain in gasoline stocks was about 1,200,000 bbls. exclusive of smaller gains in unfinished gasoline and natural gasoline.

The bureau said increases in gasoline stocks over the past winter were far below normal because of drastic cut in yields. Total stocks of finished and unfinished gasoline on March 31 totaled 94,114,000 bbls., compared with 106,773,000 bbls. a year ago.

A sharp drop was shown in daily average crude runs to stills, which were only 3,613,000 bbls. compared with 3,641,000 bbls. in February. Gasoline yield dropped to a new "modern" low of 35.8% compared with 36.7% in February (a revised figure). Yields of all fuel oils, including kerosine, also dropped in March. March and February yields, respectively, were: kerosine, 5.6% and 5.7%; distillate, 15.4% and 15.9%; residual, 29.2% and 30.2%; lubricating, 2.8% and 2.7%.

Crude Output Up

Crude production continued to rise, with March daily average reaching 3,921,300 bbls., compared with 3,871,400 bbls. in February and 3,692,700 bbls. in March 1942. Average for March was the highest since February 1942.

March gains of about 50,000 b/d in national average over February were virtually concentrated in Texas Gulf Coast, with nearly all other states and districts showing only slight changes. Illinois production resumed a downward trend but Kansas set another record with 316,000 b/d. California's average of 776,500 b/d, although not much above the preceding month, was the highest since October 1929.

Average number of completions increased in February, but the gain was primarily in dry holes. Though average initial and number drilling at the end of the month increased slightly over February, both were well below the figures of a year ago.

Why the 'Big Inch' is Flowing Again

"Found leak; fixed same."

This message, although not quite so terse, was sent to PAW by War Emergency Pipelines, Inc., just 6 days and 21 hours after the flood-drunk Arkansas River cracked the "big inch" line near Little Rock on May 17.

To the fighting forces and the gasoline starved Eastern Seaboard, a different message—telling of difficulties and long delays—might have spelled calamity.

A running account of the flood disaster to the pipeline and the work of re-establishing service between Longview, Tex., and Norris City, Ill., tells as dramatic a behind-the-lines story as may be written during this war. Such an account is contained in the report of W. Alton Jones, president of WEP, to PAW.

Here are some of the highlights of Mr. Jones' report:

May 17: Pressure gauges on the intake side of Pump Station 5, north of Little Rock, nosediving. A check 50 miles south, at Station 4, verified sudden existence of trouble somewhere between the stations. Arkansas river was swiftly approaching the record stage of 16 years. Gate valves on either side of the river crossing were closed.

Daybreak, May 18: An oil slick on north bank of the river confirmed the location of the break. A diver was already on his way to investigate. Construction barges were ordered to Little Rock for repairs when river conditions would permit.

Sundown, May 18: Found the line was punctured but not broken. Another flood crest promised by weather man.

May 19: Hopes of re-establishing throughput in the cracked pipeline river crossing abandoned. High north bank of the Arkansas sloughed off in the flood beneath the workers feet. The Rock Island Railroad bridge, 3½ miles upstream, appeared the only salvation.

Would the bridge stand up against the flood?

Would the Rock Island play ball—cooperate if a line could be run?

Would the Army Engineers approve?

Would the Missouri-Pacific grant use of its right-of-way on both sides of the river?

May 20: The answers to the questions were, "they would".

4 p. m., same day: Two crews welded the first pipe above the flood on the south bank. Ahead of them "big inch" officials and traffic experts beat their way through jammed rail terminals, corralling enough 20 in. pipe from sidings to see the 8-mile loop completed.

May 21: "Big inch" vice-presidents Hull and Horne stretched their working hours to the full 24 to see the job through.

May 22: Workers labored in the rain under make-shift canopies to run the emergency loop through the suburbs of Little Rock and up to the bridge.

May 23: Emergency loop got across.

May 24: The 4-mile stretch run to the selected tie-in point was completed. At 7 p.m. the "big inch" was delivering oil over the bridge of the Chicago, Rock Island and Pacific Railroad and on to Norris City.

The emergency loop had been laid in just 99 hours. No records for a job of this kind were broken, for there were no precedents. Anecdotes in an already colorful pipeline lore, however, piled up.

On Capitol Hill . . .

What Congress is Thinking and Doing on Oil Problems

By WILLIAM J. MADDOX, NPN Staff Writer

WASHINGTON—While they cheer as loudly as the rest at the President's capitulation to Congressional insistence that somebody be given power to knock a few heads together and put an end of inter-agency squabbling, oil members are disappointed that the new 5-man war mobilization cabinet doesn't include the Petroleum Administrator for War.

In all other respects, however, they like the new set-up, and they put a wholehearted okay on the selection of Judge Fred Vinson as the new Economic Stabilizer.

Most of them know Vinson intimately and served with him during his 14 years in Congress, 8 of which he was a member of the House ways and means committee.

Several members, commenting to NPN, went so far as to say they believed the prospects of a crude price boost had been brightened by the Vinson appointment.

Judging from a comment by Jimmy Byrnes, following his elevation to the job of War Mobilization czar, the final say on crude prices may rest with Vinson. Byrnes made it plain that he would have nothing to do with controversies over wages or prices.

His new job, as he sees it, is tightening up the policies and programming on the home front, which involves making each agency pull its own load without snapping at the other fellow.

It probably was just a random shot, but as an example of his new functions Byrnes said if a question involving oil came up he would call in Ickes, talk it over, and issue a directive for PAW to carry out.

Creation of the new super board is taken as a sign that the President himself at long last is fed up on Washington squabbles. Congress has shown its disgust with them, on the floor, in private statements, and in reports of its investigating committees.

Members are looking to Byrnes to use his new power, which is more than the President has released to any of his other czars.

In the meantime, Sen. Kilgore's bill to create a war mobilization board will be held in abeyance. If Byrnes doesn't come through as expected, the bill will be brought out.

Here are some features the Kilgore bill contains that are not included in the new set-up:

1—Control over manpower

2—Scientific and technological mobilization.

3—Larger committee.

4—An advisory committee, representing industry, labor and agriculture.

Members of Kilgore's committee are not inclined to make a fight, but they feel the 5-man committee is not inclusive enough, and that through an advisory committee it should have the advice of men outside the government. Some strong recommendation, however, may be made to Byrnes to bring this about.

Appointment of Vinson adds another link between the White House and Congress and strengthens the President's hand there. Vinson is considered an exceptionally able man and has lots of old friends on the Hill.

How important popularity among the legislators can be to a czar is demonstrated by the affairs of Price Chief Prentiss Brown. With OPA going to pieces under Congressional bombardment, Brown personally has been left pretty much unscathed.

Brown's deputy administrator Dr. J. Kenneth Galbraith was up before the Patman small business committee May 19.

"Did you ever have a business of your own, Doctor?" asked Patman.

"I ran a farm once," replied Galbraith.

"Ran a farm?"

"Yes, sir."

"What size farm?"

"One hundred seventy-five acres."

"I mean in distribution. Did you ever have any experience in the distribution field?"

"No sir; I never had any business experience in the distribution field."

Rep. Halleck broke in with the suggestion: "Let's find out what Mr. Galbraith's background is, what experience he has had with this job?"

Learning that Dr. Galbraith had been on the staff of Princeton, Harvard, University of California, had done his undergraduate work in Canada, and is a Canadian by birth, Patman returned to the farm question.

"How long did you run the farm, Doctor?" Patman asked.

"I ran the farm from the age of 17 to the age of 19."

"If you made a success out of that, you were an exception."

"The definition of success, Mr. Patman, would be somewhat difficult. I would not say I made money out of it. I kept the family fed, however."

Independent oil producers in California became acquainted with Dr. Galbraith back in 1941 when he came out there for OPA to hear their plea for a price increase—which they got 2 years later.

While they were making their arguments, he confided to the press that his mind was already made up. The oil men discovered this in the headlines of the newspapers when they went to lunch.

Mad as hornets they piled back in the hearing room, and backing Galbraith into a corner forced him to admit that the price boost had been vetoed before Leon Henderson had sent him out to hear the case.

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Eastern members, particularly those from New England, are getting ready to blow up over the gasoline and oil situation in the East.

Loudest explosion is coming from Rep. Bates, Mass., a members of Rep. Rivers' naval affairs subcommittee that has been investigating petroleum transportation behind closed doors. Chief witnesses have been Army and Navy chiefs, and not much has been forthcoming from the hearings because of the military nature of the information.

The committee thought it had wound up its hearings and was in the throes of writing its report when the present oil famine struck the East.

Hearings are to be resumed, ostensibly "to further check on army and navy requirements." But the doors of the committee room will probably be open, and Mr. Bates will be in there swinging, with witnesses from OPA.

Sen. Maloney's oil investigating committee may open up about the same time. In addition to the problems brought on by the present oil crisis in the East, the committee has some "reviewing" to do regarding prospects of keeping warm in New England next winter.

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Jed Johnson, Okla., has word that construction of the 16 in. crude pipeline from the Lubbock field in Texas to Drumright, Okla., is in the bag.

Chief question between PAW and WPB is size—16 in. or 20 in. Materials have been allocated for 16 in., however, out of 4th quarter steel. The right is reserved to increase the size if the necessity occurs.

Capacity will be 115,000 b/d. At Drumright the pipeline will hook up with lines going to Kansas City and Illinois. It will run near the Cement field in Oklahoma.

PAW was afraid the project would not be agreeable to the Oklahoma delegation because Texas crude would bypass the state's refineries. On the contrary the Oklahomans gave an enthusiastic okay.

"The more pipelines, the better," Johnson told NPN. "After the war, this line will give us an assurance that our oil will get out. We can tie in with the line. I think PAW is showing sound judgment in building pipelines. Oklahoma is enthusiastic about it."

The pipeline will tie in from the Slaughter pool and hit Oklahoma between Quanah and Childress, Tex., cutting south of Oklahoma City in a straight line to Drumright.

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Rep. Peterson's bill (H. R. 2596) to protect Naval Petroleum Reserve No. 1 is nearly ready for report to the House. A companion measure (S. 1061) introduced in the Senate by Hatch, N. Mex., is before the public lands committee, but no action will be taken until the House committee finishes its hearings. Further hearings by the Senate group may then not be necessary.

WAR ORDERS *for the* OIL INDUSTRY

Every care is taken each week to list every order, rule and regulation issued by any war agency and applicable to all branches of the oil industry. Since these orders are so numerous, however, we will appreciate our readers' cooperation in letting us know when they feel that we have omitted a regulation.

Complete copies of the official text of every order on oil can be obtained from PLATT'S OIL-Law-GRAM, 1213 W. Third St., Cleveland, Ohio, a publication which reproduces and mails out the orders on oil immediately upon issuance. Minimum charge for single copies, $1, postage paid. One year's service, $75.

Code: AO—Administrative order; RO—Ration order; L—Limitation order; M—Conservation order; P—Preference rating order; PS—Price schedule; RPS—Revised price schedule; MPR—Maximum price regulation; GMPR—General maximum price regulation; SUPP.—Supplementary; Reg.—Regulation; GO—General order.

The Week's Orders

(Issued May 22-29 inclusive)

PAW—Petroleum Administration for War
Dir. 67—Zoning in District 3
RO—Ration Orders
1A—Tires, Am. 30
7—Ration coupons, Am. 3
11—Fuel oil, Am. 65
PR—Prices
88—Fuel oil, Am. 103
GMPR—Pricing, Am. 54
ODT—Office of Defense Transportation
GO 17—Local Deliveries, Am. 3
GO 39—Busses, taxicabs
M Orders
M-159—Butyl alcohol
M-275—Alkanolamines
EO—Executive Orders
9346—Discrimination
9347—Office of War Mobilization

Digest of Week's War Oil Orders

PAW—Petroleum Administration for War

DISTRICT 3—Dir. 67—Zoning regulations established for transportation of motor fuel within states of Alabama, Mississippi, Louisiana, Arkansas, Texas and New Mexico and from District 2 to such states (see text of order below and story on p. 0); issued 5/22, released 5/29.

OPA—Office of Price Administration

FUEL OIL PRICES—RPS 88, Am. 103—Dollar and cents ceilings set for No. 2 fuel oil in Schenectady county and in Ballston Lake, Burnt Hills, Charlton, Elnora, Galway, Rexford and W. Charlton in Saratoga county, N. Y. as follows: delivery into buyer's tank wagons—7.2c per gal.; tank wagon deliveries to consumers in any quantities—8.8c per gal.; issued 5/27, effective 6/2.

FUEL OIL RATIONING—RO 11, Am. 65—Rations will be issued for domestic hot water and cooking even though convertible equipment is available; rations to be issued after June 1 in Zones A and B and after May 15 in Zones C and D; issued 5/24, effective 5/29.

PRICES—GMPR, Am. 54—Manufacturers may set their own prices for products covered by GMPR and not sold by them or any competitor in March, 1942; price is to be reported to nearest field office within 10 days of determination. New price is to be arrived at as follows: maximum price for a product comparable to product to be priced is divided by direct costs of comparable product to find mark-up factor; this factor is multiplied by direct costs of product being priced and result is new maximum. Issued 5/24, effective 5/29.

RATION COUPONS—GRO 7, Am. 3—Fuel oil ration coupons may not be placed in envelopes for deposit or surrender, but must be placed on gummed sheets or cards; issued 5/24, effective 5/26.

TIRE RATIONING—RO 1A, Am. 30—Applications for authority for downstream transfers without certificates may be made by transferor only, not by transferee; issued and effective 5/27.

ODT—Office of Defense Transportation

BUSSES—GO 39—All busses and taxicabs in East Coast area north of and including Virginia must cut mileage to 80% of total number of miles operated during week ending May 22, 1943; issued and effective 5/27.

LOCAL DELIVERIES—GO 17, Am. 3—Number of retail and wholesale deliveries to be made in one week from one point of origin to one point of destination is limited according to commodity delivered; delivery routes of companies may not duplicate or overlap; Sunday deliveries forbidden except for ice, milk and cream; petroleum deliveries (not listed among specific commodities, but in general restriction) are limited to 2 per week, whether retail or wholesale; order applies in Eastern gasoline shortage area; issued 5/24, effective 5/27.

WPB—War Production Board

ALKANOLAMINES—M-275 as amended May 25—Diethylethanolamine placed under allocation and triethanolamine removed; issued and effective 5/25.

BUTYL ALCOHOL—M-159 as amended May 26—Acetic esters included in butyl alcohol restrictions; issued and effective 5/26.

EO—Executive Orders

DISCRIMINATION—EO 9346—Employers in war industries are ordered to eliminate discrimination in employment by reason of race, creed, color or national origin; Committee on Fair Employment Practices organized under OEM to carry out order; issued 5/27.

OFFICE OF WAR MOBILIZATION—EO 9347—Office of War Mobilization established for coordination of work of war agencies with production, procurement, transportation and distribution of military and civilian supplies, materials and products; issued 5/27, released 5/28.

Official Text of Important Orders

Supply, Distribution Zoning Ordered for District 3

TITLE 32—NATIONAL DEFENSE
CHAPTER XIII—PETROLEUM ADMINISTRATION FOR WAR
PART 1545—PETROLEUM SUPPLY
PETROLEUM DIRECTIVE 67

The shortage of facilities for the transportation of petroleum has created in certain areas shortages in the supply of petroleum for defense, for private account, and for export, and has made it imperative that all such facilities be used with maximum efficiency, that all unnecessary back hauling, cross hauling, and other movement of petroleum be eliminated; and the following operating Directive is deemed necessary for the prosecution of the war.

Section 1545.6 Petroleum Directive 67

(a) *Definitions.*

(1) "Person" means any individual, partnership, association, business trust, corporation, governmental corporation or agency, or any organized group of persons whether incorporated or not.

(2) "Original supplier" means any person who at the date of the issuance of this Directive refines petroleum or operates a recycling plant in the United States and sells petroleum products for delivery in District Three, or who distributes petroleum products through a terminal in District Three.

(3) "Petroleum products" means motor fuel, kerosene, range oil, tractor fuel, distillate fuel oils, and residual fuel oils.

(4) "District Three" means the States of Alabama, Mississippi, Louisiana, Arkansas, Texas, and New Mexico.

(5) "Refinery Marketing Area" means those Areas within District Three numbered 1 to 11, as described in Exhibit "A" hereof.

(6) "Neutral Area" means those counties listed in Exhibit "B" hereof, which shall be considered to be a part not only of the Refinery Marketing Area in which they are specifically included in Exhibit "A" but also a part of each Refinery Marketing Area to which they are contiguous.

(7) "Terminal" means any storage plant supplied with petroleum products by pipe line or river barge, as distinguished from bulk distributing stations or refineries.

(b) *Surveys and Investigations.*

Subject to the supervision of the Director of Petroleum Supply, or such District Director as he may designate, the General Committee for District Three shall obtain, analyze, and keep current such pertinent and available facts, figures, and other data with respect to the available supplies of petroleum products and transportation facilities in, to, and from District Three as may be necessary or appropriate in connection with the performance of the functions and duties with which the General Committee for District Three is charged hereunder: *Provided*, that whenever available such facts, figures, and other data shall be obtained from other appropriate committees or subcommittees rather than by new surveys or investigations.

(c) *District Three Petroleum Supply Operations.*

Subject to the supervision of the Director of Petroleum Supply, or such District Director as he may designate, the General Committee for District Three shall arrange for purchases, sales, exchanges, and loans of motor fuel among original suppliers in District Three when any such transaction will:

(1) Eliminate or shorten the movement of motor fuel by pipe line, barge, or tank car facilities within the confines of District Three: *Provided*, that such transaction does not result in a wasteful use of any such transportation facility within or outside of District Three; or

(2) Eliminate a movement or movements of motor fuel from District Two to District Three, except:

(i) To the Counties of Benton, Carroll, Boone, Washington, Madison, Newton, Crawford, Sebastian, and Franklin of the State of Arkansas; and

(ii) Tank truck deliveries from river terminals in the immediate vicinity of Memphis, Tennessee, into Areas 9 and 10; or

(3) Result in a substitution of a pipe line movement or movements of motor fuel for a movement or movements by barge, tank car, or transport truck; or

(4) Eliminate cross hauling or back hauling of motor fuels.

Provided, that no such transaction shall be arranged that results in any movement of motor fuel for distribution or consumption from one Refinery Marketing Area into another such Area except eastward or northward movements between Areas 11, 4, 7, and 10.

(d) *Elimination of Unnecessary Movements Within District Three.*

For the primary purpose of furthering the war effort by conserving transportation facilities for movement of motor fuel in a northerly and easterly direction, and in order (by so doing) to maintain for local consumers an adequate supply thereof, the General Committee for District Three shall, subject to the supervision of the Director of Petroleum Supply, or such District Director as he may designate, arrange for exchanges, loans, sales, and purchases of motor fuel between and among original suppliers in District Three which will eliminate to the maximum extent the movement of motor fuel between the Refinery Marketing Areas described in Exhibit "A" hereof. Original suppliers in District Three shall eliminate inter-area shipments between such areas and shall obtain necessary supplies and dispose of surpluses of motor fuels by means of exchanges, loans, sales, and purchases as provided in the foregoing sentence: *Provided*, that nothing herein contained shall be deemed to prohibit the movement of motor fuel from Areas 4, 7, 10, or 11 to any point outside of District Three or any eastward or northward movement of motor fuel between Areas 4, 7, 10, or 11, and, *Provided further*, that nothing contained herein shall be deemed to prohibit the shipment from any Refinery Marketing Area described in Exhibit "A" hereof to a depth of 10 miles in any area adjacent thereto or the ship-

ment from any such area into a contiguous neutral area.

(e) *Extension of Applicability of Directive to Other Petroleum Products and Changes of Area Boundaries.* The provisions of this Directive may be extended, in whole or in part to any other petroleum product contained in the definition of petroleum products in paragraph (a) hereof, and the boundaries of the several areas described in Exhibits "A" and "B" hereof may be changed by the Director of Petroleum Supply whenever he finds that such action will conserve transportation facilities, alleviate a shortage of a petroleum product or products, or in any other manner further the objectives of this Directive. Such an extension of this Directive may be made applicable to any one or more or to all of the areas defined in Exhibits "A" and "B" hereof.

(f) *Sales, Loans, and Exchanges.*

(1) The terms and conditions of any exchange, loan, sale, or purchase made pursuant to this Directive shall be subject to negotiation between the parties to any such transaction: *Provided*, that no price agreed upon shall exceed any applicable ceiling price established by the Office of Price Administration, and, *Provided further*, that if the parties to any such transaction are unable to agree upon the price or other terms and conditions for furnishing any of the petroleum required to be sold, exchanged, or loaned under this Directive, or for the use of any facilities, any such dispute shall be referred to the Director of Petroleum Supply, or such District Director as he may designate, for such action as he may direct.

(2) All exchanges, loans, sales, and purchases pursuant to this Directive shall be effected, in so far as practicable, in such a manner as to provide to customers, including intermediate suppliers, of original suppliers in each of the areas an equitable share of the supplies of motor fuel available in each such area.

(g) *Determination of Requirements.*

The General Committee of District Three, in collaboration with the Refining Committee for District Three, shall analyze and determine the amounts of motor fuel available to Areas 1, 2, 3, 5, 6, 8, and 9. The General Committee shall make recommendations to the Director of Refining with respect to the amounts of motor fuel necessary to meet the needs of each such area.

(h) *Movement of Surpluses to Other Districts.*

The General Committee for District Three shall advise the Transportation Committee of District Three of, and the Transportation Committee shall arrange with the appropriate Committees for other Districts and with the Petroleum Administration for War for transportation facilities to move to such other Districts, such surpluses of petroleum products as may be created in any area of District Three by the operation of this Directive. Such arrangements shall be in accordance with the provisions of Petroleum Directive 59, as amended, or as hereafter amended, and, as respects shipments to District Two, in accordance with the provisions of Petroleum Directive 65.

(i) *Authority of General Committee to Delegate the Duties and Responsibilities Subject to its Authority and Control.*

The General Committee for District Three may delegate to any committee or subcommittee established under the authority of the Petroleum Administration for War the performance, in whole or in part, of the functions and duties vested in it by this Directive, subject to the control and direction of the General Committee for District Three.

(j) *Administration.*

In carrying out the duties, responsibilities, and functions imposed upon it by this Directive, the General Committee for District Three shall consult with appropriate committees to the extent that activities hereunder may affect such committees and subcommittees. Meetings of the General Committee for District Three and other committees, subcommittees, and persons who may be affected by this Directive may be held from time to time for the purpose of doing all things necessary to carry into effect the provisions of this Directive. The General Committee shall maintain such staff and appoint such persons as it finds necessary to carry out its responsibility, duties, and functions under this Directive. Operating expenses of the Committee shall be met as provided in Section 1500.7 of this chapter.

(k) *Appeals.*

Any person affected by this Directive or any action taken hereunder who considers that compliance therewith would work an exceptional and unreasonable hardship upon him may appeal to the District Director in Charge of the Office of Petroleum Administration for War for District Three, 247 Mellie Esperson Building, Houston, Texas, setting forth the pertinent facts and reasons why he considers himself entitled to relief, which Director shall act promptly upon such appeal and render a decision thereon within a period of fifteen days. If dissatisfied with the decision of the District Director in Charge, such person may appeal within fifteen days after receipt of notice of the District Director's decision to the Deputy Petroleum Administrator, or such representative as he may designate.

(l) *Revocation of Conflicting Provisions of Plan 16 as Revised.*

To the extent of such conflict only, all provisions of Plan 16, Revised, entitled a "Plan for the Appointment of a Supplies and Distribution Subcommittee for District No. Three and for Increasing the Movement of Petroleum and Petroleum Products from District No. Three to District No. One and for Increasing the Efficient Use of Facilities in District No. Three", which are in conflict with the provisions of this Directive are hereby revoked.

(E.O. 9276, 7 F.R. 10091)

Issued this 22nd day of May, 1943.

(Sgd) RALPH K. DAVIES,
Deputy Petroleum Administrator
for War.

EXHIBIT "A"

REFINERY MARKETING AREAS

Area 1: The Counties of McKinley, Sandoval, Santa Fe, Bernalillo, Valencia, Catron, Socorro, Lincoln, DeBaca, Chaves, Lea, Eddy, Otero, Dona Ana, Luna, Sierra, Grant, and Hidalgo of the State of New Mexico; the Counties of El Paso, Hudspeth, Culbertson, Reeves, Pecos, Terrell, Brewster, Presidio, and Jeff Davis of the State of Texas.

Area 2: The Counties of San Juan, Rio Arriba, Taos, Colfax, Union, Torrance, Harding, Mora, San Miguel, Guadalupe, Quay, Curry, and Roosevelt of the State of New Mexico; the Counties of Dallam, Sherman, Hansford, Ochiltree, Lipscomb, Hartley, Moore, Hutchinson, Roberts, Hemphill, Oldham, Potter, Carson, Gray, Wheeler, Deaf Smith, Randall, Armstrong, Donley, Collingsworth, Parmer, Castro, Swisher, Briscoe, Bailey, Lamb, Hale, Floyd, Cochran, Hockley, and Lubbock of the State of Texas.

Area 3: The Counties of Yoakum, Terry, Lynn, Garza, Kent, Stonewall, Gaines, Dawson, Borden, Scurry, Fisher, Jones, Shackelford, Stephens, Palo Pinto, Andrews, Martin, Howard, Mitchell, Nolan, Taylor, Callahan, Eastland, Erath, Loving, Winkler, Ector, Midland, Glasscock, Sterling, Coke, Runnels, Coleman, Brown, Comanche, Ward, Crane, Upton, Reagan, Irion, Tom Green, Concho, McCulloch, Mills, San Saba, Crockett, Schleicher, Menard, Mason, Sutton, Kimble, Valverde, and Edwards of the State of Texas.

Area 4: Llano, Burnet, Williamson, Gillespie, Blanco, Travis, Bastrop, Hays, Caldwell, Kerr, Real, Bandera, Kendall, Comal, Guadalupe, Kinney, Uvalde, Medina, Bexar, Wilson, Gonzales, Maverick, Zavala, Frio, Atascosa, Karnes, De Witt, Lavaca, Dimmit, La Salle, McMullen, Live Oak, Bee, Goliad, Victoria, Jackson, Calhoun, Refugio, Aransas, San Patricio, Nueces, Kleberg, Jim Wells, Duval, and Webb of the State of Texas.

Area 5: The Counties of Hall, Childress, Motley, Cottle, Crosby, Dickens, King, Hardeman, Foard, Knox, Haskell, Wilbarger, Baylor, Throckmorton, Wichita, Archer, Young, Clay, Jack, Montague, Wise, Cooke, and Grayson of the State of Texas.

Area 6: The Counties of Fannin, Lamar, Red River, Delta, Denton, Collin, Hunt, Parker, Tarrant, Dallas, Rockwall, Kaufman, Van Zandt, Hood, Somervell, Johnson, Ellis, Bosque, Hill, Navarro, Henderson, Hamilton, Lampassas, Coryell, McLennan, Limestone, Freestone, and Anderson of the State of Texas.

Area 7: The Counties of Bell, Falls, Milam, Robertson, Leon, Houston, Madison, Brazos, Burleson, Lee, Washington, Waller, Grimes, Montgomery, Walker, Trinity, San Jacinto, Polk, Angelina, San Augustine, Sabine, Newton, Jasper, Tyler, Hardin, Orange, Jefferson, Liberty, Chambers, Galveston, Harris, Brazoria, Ft. Bend, Wharton, Austin, Colorado, Fayette, and Matagorda of the State of Texas; the Parishes of Vernon, Beauregard, Allen, Evangeline, Acadia, Jefferson Davis, Calcasieu, Cameron, and Vermilion of the State of Louisiana.

Area 8: The Counties of Hopkins, Franklin, Titus, Morris, Camp, Rains, Wood, Upshur, Marion, Harrison, Panola, Gregg, Rusk, Nacogdoches, Cherokee, and Smith of the State of Texas.

Area 9: The entire State of Arkansas except the Counties of Benton, Carroll, Boone, Washington, Madison, Newton, Crawford, Franklin, and Sebastian; the Parishes of Caddo, Bossier, Webster, Claiborne, Union, Morehouse, West Carroll, East Carroll, Lincoln, Bienville, Jackson, Ouachita, Richland, Madison, De Soto, Red River, Winn, Caldwell, Franklin, Tensas, Sabine, Natchitoches, Grant, La Salle, Catahoula, and Concordia of the State of Louisiana; the Counties of Bowie, Cass, and Shelby of the State of Texas.

Area 10: The entire State of Mississippi; the entire State of Alabama; the Parishes of Rapides, Avoyelles, Pointe Coupee, St. Landry, Lafayette, St. Martin, Iberville, West Baton Rouge, East Baton Rouge, West Feliciana, East Feliciana, St. Helena, Livingston, Tangipahoa, Washington, St. Tammany, Orleans, St. Bernard, Plaquemines, Jefferson, La Fourche, Terrebonne, St. Charles, St. John the Baptist, St. James, Ascension, Assumption, St. Mary, and Iberia of the State of Louisiana.

Area 11: The Counties of Zapata, Jim Hogg, Brooks, Kenedy, Starr, Hidalgo, Willacy, and Cameron of the State of Texas.

EXHIBIT "B"

NEUTRAL AREAS

1. The Counties of Santa Fe and Torrance of the State of New Mexico.

2. The Counties of Grayson, Bowie, Cass, and Nacogdoches of the State of Texas.

3. The Parishes of Vernon, Rapides, Avoyelles, Concordia, Tensas, Madison, East Carroll, and West Carroll of the State of Louisiana.

WLB Tightens Rules On Wage Hikes

National War Labor Board has tightened restrictions around individual wage and salary adjustments which can be made without board approval. Action was taken in General Order No. 31, amending General Orders Nos. 5 and 9.

After May 31, no individual increases may be made without board approval unless they are within a salary or wage rate schedule which conforms to one of the following:

1—Such a schedule when specifically approved by WLB.

2—It is contained in a collective bargaining agreement in existence on May 31.

3—It conforms to the employer's practice prior to Oct. 27, 1942. The employer can demonstrate this through either his payroll records or by showing that he has formally communicated such a schedule to his employes.

If employers do not have a plan for making individual adjustments, WLB said, they can either apply to the board for approval of one or they can make adjustments in accordance with the following:

1—Merit increases can be made only within rate ranges for the job and must be governed by the following: (a) they must be individual adjustments made as a reward for superior quantity or quality of work or service; (b) no employe may receive more than 2 merit increases during any calendar year; (c) except in cases where there have been substantial fluctuations in employment, no more than half of the average number of employes in a job classification may receive merit increases during any calendar year; (d) no merit increase may exceed one-third of the difference between the minimum and maximum rates for the job.

2—Automatic length of service increases can be made only within rate ranges for the job and must be governed by the following: (a) they must be individual adjustments usually made automatically at the end of specific periods of satisfactory service; (b) not more than 4 such increases may be given in any calendar year; (c) amount of adjustment may not exceed one-fourth of the difference between minimum and maximum rates for the job.

3—Promotions or reclassifications are governed by the following: (a) they must be individual adjustments resulting from moving an employe into a different job classification; (b) an employe may receive a rate not in excess of 15% above his rate on his former job or the maximum rate for the new job, whichever is higher, provided that where an employe has special ability and experience he may be paid a rate within the appropriate rate range corresponding to such ability and experience.

4—Apprentice or trainee plans are governed by the following standards: (a) individual rate adjustments may be made if employe shows improvement in his productive ability over specified periods of time; (b) such plans should conform to the standards of a collective bargaining agreement or regulations of federal or state agencies.

WLB said it had found some employers were circumventing the wage stabilization program by granting wage increases on grounds that they were within an established schedule when, in fact, no such schedule was in existence.

The EDITOR'S Page

Readers comments and opinions will be much appreciated by—WARREN C. PLATT, NPN's Editor and Publisher, Penton Building, Cleveland, O.

If Government Subsidy Had Brought In The Famous East Texas Oil Field

THE uproar within and about OPA, and the establishment of the new Office of War Mobilization, leads more strongly than ever to the conclusion that the Roosevelt administration is at last getting supply-minded.

These changes also suggest, as the shortage of petroleum products increases due to lack of transportation and unanticipated war demands, that the administration may also be more supply-minded as to petroleum and its products, and less concerned about prices and some of the revolutionary economic and social theories of its economists and professors.

It now looks as if the subsidy idea first promoted by the late OPA chief, Leon Henderson, and since developed by some of his ardent followers, will get a try-out in the food situation before it has a chance to be applied to the oil industry.

The non-New Dealers are viewing this food try-out quite skeptically. They are alarmed at the possibilities for more misunderstanding and confusion, as well as the awe-inspiring possibility of an endless, increasing drain on the people's treasury. Commentators are saying that subsidizing the food industry as well as other industries will only serve to aid inflation, in that it will be far easier for people to ask for and approve increasing drains on the public treasury than to pay any increased costs directly out of their own pockets.

OPA's recommendation for a subsidy of wildcat drilling would put the government into the oil industry in the worst way possible for the state of the government's treasury, and for any possibility of continued freedom of enterprise in oil producing.

If the government were to be launched today on a policy of subsidizing wildcatting then the demands on it would increase as the supply of crude oil declined, and that supply is declining rapidly, and dangerously so.

Once the government participates in the search for crude oil it is quite certain that it is going to be increasingly generous in its contractual relations with various voting blocs. Oil has not necessarily been found and produced by professional oil men. A great deal of the exploratory drilling has been at the instigation and with the aid of men in other lines of business, and a great deal of the flush production in new pools has been brought in by newcomers to the oil industry. Once the government is launched on finding oil on other people's lands, it is easily conceivable that it can be called upon to put up an increasing percentage of the cost and to test out with a drill the acreage owned or leased by all sorts of voting groups, including the administration's well-known friends, the labor unions, because labor unions who may have accumulated a lot of cash have not stayed to the business of running unions.

We have also but to look to the administration's generosity to the farmers for indications of probably increasing generosity on any drilling deals. If the country is scared enough over a shortage of oil, it is conceivable that there would be thousands of test rigs on thousands of blocks of property paid for by the government and promoted by those who are best known to Washington.

But in addition to the possibility, in fact the certainty, of hundreds of millions of dollars being wasted in wildcat drilling, when it is government money, there is the other side of the picture.

Does anyone think for a minute that if the federal government were to put up the money drilling the wildcats that might bring in a second East Texas field, it would be satisfied just to draw down its overriding royalty? With much government money tied up in these new pipelines, and more government money actually lost in unnecessary wildcats, one can hardly picture an administration, or even Congress, being satisfied to let a new field be operated by its private owners.

We would most certainly have government operation, or at least government domination of the oil business in any such event, and the extent of that domination would be solely the size of the field discovered.

The oil industry can easily recall how difficult it was in the days of the flush production of the East Texas field to get the cooperation of the state governments in legitimate conservation of that field. The oil industry will also recall the difficulty in getting the cooperation of the federal government for such conservation. The industry may also recall that the only section of its famous NRA Code that would have permitted the federal government's exercising any restriction on the wasteful flow of crude from that East Texas field mysteriously disappeared from that document while it was in transit from the official oil industry committee to the White House for signature, and they will also recall that when its absence was discovered a year later or so, the administration never offered any explanation as to why the only tooth in the law against the "hot" oil producers in the East Texas field, the boys who were supplying ultra-cheap gasoline at big profits to themselves, was surreptitiously drawn.

The oil industry needs but look to that and a number of other instances that occurred in connection with the industry's battle for the development and enforcement of true conservation in the East Texas field, to find plenty of reasons for viewing with grave doubt any participation, by at least this administration, in oil field production as being in the interest of free enterprise.

So not only in the interest of free enterprise, but in the interest of actually getting the oil, it is to be hoped that Mr. Ickes will be adamant in his opposition to government subsidy of drilling operations, and at the same time be able to convince the new super-duper operating board—OWM—that what this country and the oil industry needs is an intelligent program for sufficient petroleum supplies for war and essential purposes, and that whether such a program raises the price of gasoline a cent or even two cents is but an incident in our effort to win the war.

Advertises Oil Industry's Multiple Ownership

THE true picture of just who owns business, and particularly the oil business, has never been properly impressed upon the public's consciousness. The result is that those seeking votes have been able to conjure up some ogre known as "Wall Street" or "The Interests", or "Monopolies" as being the owners of business. These bedtime ghost stories have prevented the public from realizing that it's the public that owns business.

The oil industry has an especially good story to tell about its wide ownership according to a survey made several years ago by NPN. It was conservatively estimated then that more than a million everyday Americans owned the oil industry, big companies and little companies.

That survey showed that there were probably stockholders of oil companies in every town and hamlet even under a thousand population in the country; that on practically every main street of the country's towns and cities are stockholders.

Now comes the Union Oil Co. of California, in advertising in general magazines about who owns that oil company and who owns the oil industry. It is good, plain-fact copy.

In telling its story the Union tells some things about oil operations which are interesting and constructive. In a recent advertisement entitled "How to Drill an Oil Well for $2.08", the Union makes the point that when it drills a well it is drilled by 31,652 people, and that last year its average wells ran $65,888.00 each. Hence, when divided by the number of all these people, it amounts to $2.08 per person.

These 31,652 people are Americans and owners of stock in The Union Oil Company. The

Union calls this "multiple ownership". In this same advertisement, in eight short paragraphs, it shows the reader how easy it is to drill a well for $2.08 per person, and how difficult, even impossible, it would be to drill very many of them at $65,888 per person. This particular advertisement of the Union brings out that drilling today costs 26 times as much as in 1890; that dry holes are on the increase.

This "multiple ownership", the Union points out, permits Americans "to pool the money and the talents of a lot of people" to "tackle certain operations collectively that we could never handle alone", and it points out this is how so many of the comforts of life, that cost so little today, have been produced.

We have frequently contended that neither the major oil companies, nor other large companies, have succeeded in making their average stockholders conscious of ownership; that is in putting their average stockholder always on the alert for ways in which that stockholder can help his or her company.

The much-talked-of cooperative movement in oil and other lines is nothing but a collective ownership, the same as in the case of ordinary stock companies, except that the name is different, and particularly, except that the organizers and operators of the cooperative companies have never lost sight of the fact that their strength lies in keeping their individual stockholders, no matter how few shares they may hold, fully conscious of their interest in the company, and always alive to take full advantage of every opportunity that may be offered for them to further the interests of their cooperatively-owned company.

IN THE case of independent oil companies, whether producing, refining, or marketing, the stockholders are generally kept in closer touch with the operation of the business because of their smallness. Generally those stockholders are in one town or in a limited area, with the result that stockholders are far more constructive factors on behalf of their independent companies, than when those same stockholders also own stock in major oil companies.

If every one of the million and more stockholders of companies in the oil industry were as alive to their ownership in all companies and in the industry as are the stockholders in the average cooperative oil company, it certainly should be a safe prediction that the industry would not be kicked around politically as much as it has been.

When one analyzes the stock ownership of the oil industry, including the big companies, one is surprised at how far down into the so-called middle class, and even the so-called lower class, stock ownership of oil companies goes.

Certainly the oil industry is owned anywhere but in "Wall Street."

The Union Oil Co.'s present advertising on "Multiple Oil Industry Ownership" should be read by every oil man, big or little, and in fact by every oil company stockholder, because the more the multiple ownership idea is held by the average oil industry stockholder and employe the better it will be for the industry.

Will It be Government Oil Marketing?

THE proposal of RFC to loan money to hard-pressed small oil companies reads very much like an ordinary banking proposition. It raises the question, if the government is so solicitous of the small businessman, why it would not be far better to permit wider margins instead of insisting on narrow margins and low price ceilings. These would seem to force the small businessman to bring his belongings around to the government pawn shop.

One can almost suspect that there might be a conspiracy between OPA and RFC for the former to force the businesses of small merchants into the latter.

The reading of the RFC proposition, as printed on page 3 of the May 19th issue of NPN, would seem to say that if the small oil company still has some net income, RFC will loan amounts not to exceed 75% "of the normal value of the property".

That at once brings up the question of what is the "normal value" of the property and what will the RFC Mortgage Co. use as a yardstick of that normal value? It would seem that the business, in the first place, must have some net income and, in the second place, that the lenders must be able to foresee that immediately after the war the property will have sufficient income to pay off the loan. This sounds like an ordinary banking proposition, unless the government is going to be very generous in determining the "normal value" of the property. In the case of an oil company that is suffering from gallonage loss due to gasoline and fuel oil rationing, will the "normal value" be determined as of a date before rationing, or in the early days of rationing, or on an assumption as to the severest extent of rationing?

But assuming that the government gets real generous and loans money on a few thousand oil marketing properties, and assuming that Congress does not allow any income tax exemption on funds laid aside for postwar rehabilitation and modernization, and assuming that the major oil companies still have money on hand at the end of the war to put in the very latest and most efficient of distributing equipment, and assuming that because of all these things the small oil man can't make a go of it after the war—then what is the government going to do with these oil properties? Operate them?

At various times in the past years, different state governments, generally on behalf of a governor's candidacy for re-election, or for election to the U. S. Senate, undertook to peddle gasoline, generally from facilities of its road-building department. In these instances gasoline was generally sold at a cut price and with a loud blare of trumpets as to the keen perspicacity and great generosity of the gubernatorial candidate for the interests of the common people. Such government ventures into the oil business were terribly expensive to the industry because prices were knocked down to unprofitable levels. At the same time the public wasn't served because immediately after election these government enterprises were generally closed up, the votes having been counted.

Question—Will Washington, and particularly the present administration if it should be continued after the war, undertake to outdo the generosity and magnanimity of all of these relatively puny state efforts in price cutting?

Support Grows for Exemptions For Postwar Rehabilitation

THE idea of permitting business to set aside some cash, say in special war bonds, for conversion to peacetime operations at the close of the war seems to be growing.

Washington commentators keep referring to it as a possibility and even as a necessity, especially if small business is to be continued.

Every independent oil men's association should be supporting this actively. They should be talking to the various business committees at Washington and writing to their senators and congressmen. Specifically, the independent oil man could ask for some income tax exemption for the balance of the war, to be set aside for his use after the war in the rehabilitation of his business with modern equipment.

Any such exemption, of course, presumes there will be profits from which such exemptions can be made. Therefore part of the oil man's story to the authorities at Washington would also be the granting of proper margins to give him some reasonable profits from which the deductions for postwar rehabilitation can be made.

The more frequently and the harder the independents keep writing their Washington representatives, the more likelihood there will be of getting special consideration for the maintenance of their competition in the oil business.

Ignition Rivals Tires As '42's Auto Jinx

NPN News Bureau

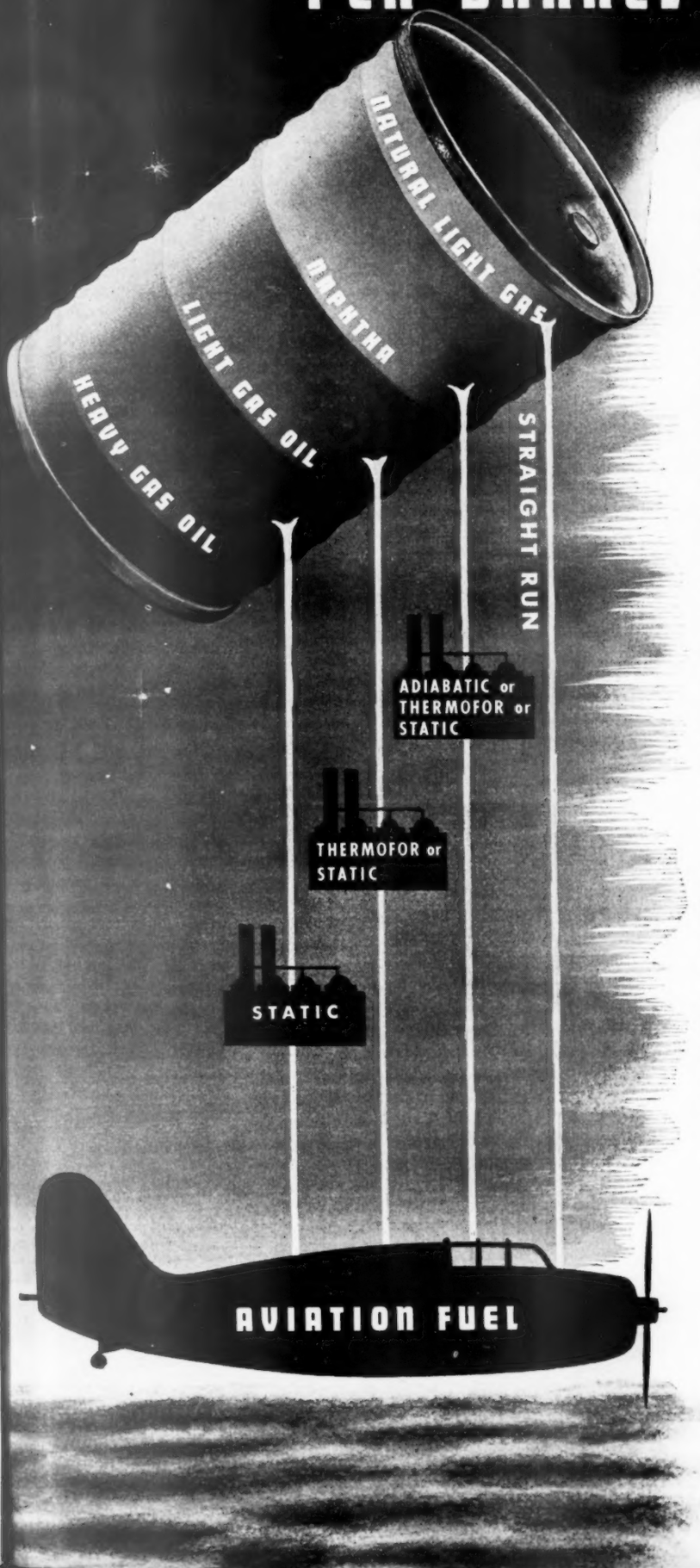
WASHINGTON — Although flat tires continued to be a principal cause for automobile breakdowns in 1942, American Automobile Assn. reports that a tremendous increase in battery, ignition and starter troubles was an outstanding development during the first year of motoring under rationing.

The A.A.A. statement was based on a study of principal causes for automobile breakdowns based on reports from the 11,000 garages throughout the U. S. under contract to render emergency road service to A.A.A. members.

A table giving detailed estimates on various causes for breakdowns follows:

Type of Service	Number of Breakdowns 1942	1941
Tire	10,898,000	9,505,000
Ignition	7,456,000	4,548,000
Battery	5,723,000	5,538,000
Tow	4,750,000	3,069,000
Starter	2,018,000	955,000
Stuck (sand, mud, snow)	1,490,000	1,429,000
Out of Gas	878,000	1,163,000
Wrecker—Crane	851,000	1,234,000
Gas Line	669,000	589,000
Carburetor	498,000	589,000
Frozen	380,000	109,000
Lock and Key	346,000	691,000
Miscellaneous	2,044,000	2,582,000
Total	**38,000,000**	**31,000,000**

MAKE MORE CATALYTIC AVIATION GAS PER BARREL OF CRUDE



Houdry offers licenses for all the catalytic cracking processes needed for maximum yield and quality

Largest licensor in the industry, based on refining capacity, Houdry offers not one but *three* catalytic cracking processes for the production of aviation fuel. Each process is especially suited to certain types of refinery operation and certain charging stocks.

Houdry Static Catalyst Process: First process to produce aviation gasoline by cracking. Highly versatile, it efficiently cracks naphtha, gas oil and heavier oils. Last year produced more than 90% of *all* catalytically cracked aviation fuel. Seventeen plants in operation, ten more under construction.

Thermofor Catalytic Cracking: Embodies the continuous movement of catalyst through a reactor and a regenerator. Unquestionably the most efficient process of its type. Provides particularly high yields from gas oil but can crack naphtha as well. Adaptable to almost any size of refinery. T.C.C. makes available to small and large refiners a catalytic cracking process requiring low amounts of critical construction materials, low operating cost, and is highly economical for the production of catalytically cracked aviation base stocks of superior quality. Twenty-two plants now in various stages of construction.

Houdry Adiabatic Process: Latest Houdry development can produce a *super* aviation fuel incomparably superior to present aviation fuels. Uses as charging stock heavy naphthas heretofore almost useless for aviation gasoline, thus substantially increasing total possible yield per barrel of crude. Semi-commercial unit, now in operation, indicates Adiabatic plants will cost less to build and operate than static catalyst plants.

These Houdry-licensed processes assure maximum production of high-octane aviation fuel from crude, with minimum materials required for construction and operation of plants. Houdry offers these outstanding processes to all American refiners without restriction, under license arrangements subject to approval by the U. S. Government.

HOUDRY PROCESS CORPORATION
Wilmington, Delaware

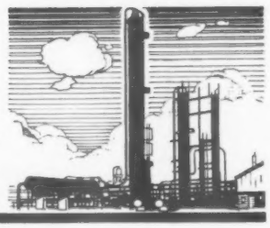
HOUDRY CATALYTIC PROCESSES
... FOR VICTORY IN WAR
... FOR PROGRESS IN PEACE

Licensing Agents:

E. B. BADGER & SONS CO.
Boston, Massachusetts

THE LUMMUS COMPANY
New York City, New York

BECHTEL-McCONE-PARSONS CORP.
Los Angeles, California



100-Octane Cuts Diesel Supply

Fuels for Diesels to be Critically Short by End of 1944 as Distillate Yields Suffer from High Aviation 'Gas' Output, Authority Says

NPN News Bureau

CLEVELAND—At the present rate of production of high octane aviation gasoline at the expense of yields of kerosine and distillate fuels, suitable Diesel fuels will be on the critical list by the end of 1944, it is stated by C. M. Larson, New York, chief consulting engineer for Sinclair Refining Co., in a paper to be presented June 3 at the Diesel Engine and Fuels and Lubricants meeting of the Society of Automotive Engineers here.

If the conversion of refinery yields to produce 100-octane gasoline continues at the intended rate, the ratio of gasoline to distillate fuel production in 1945 will be 7 to 1 whereas at the start of the war it was 3 to 1, according to Mr. Larson, who is a consultant to the Secretary of War on lubricants and to other government agencies on petroleum products.

Assuming that the present emphasis on output of aviation gasoline is continued, the production of principal refined products in 1945 is estimated by this authority as follows: gasoline, 700,000,000 bbls.; kerosine, 50,000,000 bbls.; distillate fuels, 100,000,000 bbls.; and residual fuels, 400,000,000 bbls.

Gives 1940 for Comparison

Figures on 1940 production of the same products—showing the stimulus of wartime demand on gasoline and residual fuel production at the expense of distillates when compared with the 1945 estimate were given in Mr. Larson's paper as follows: gasoline, 614,867,000 bbls.; kerosine, 72,150,000 bbls.; distillates, 180,000,000 bbls.; residual fuels, 356,000,000 bbls.; lubricating oils, 35,151,000 bbls.

From these refinery operating conditions, Mr. Larson draws these conclusions in his paper, titled "Octanes or Cetanes After World War II":

"The so-called housebrand or regular grade gasoline will be 80-octane such as is now used by the Army for all ground vehicles using gasoline.

"Premium grade will be 87 to 90 octane, just above where Buick was when its design engineers had to cut back on octane requirements of the car.

Sees 72-75 Octane 3rd Grade

"Third grade gasoline will be 72 to 75 octane for the many serviceable cars, left over after the war, awaiting obsolescence.

"Tractor or distillate fuels of 50 octane or 40 cetane will be available. (Cetane number is a method of expressing the ignition quality of a Diesel fuel in terms of the proportion of the cetane hydrocarbon compound in a test mixture, just as the anti-knock value of motor fuel is expressed by the proportion of iso-octane.)

"Kerosine as known in the past will be had.

"Of course, plenty of 100-octane aviation gasoline will be available but much of the material will find its way into the 80-octane regular or the premium grade 88.

"Diesel fuels will be available but in many geographic areas the tractor distillate types of fuel will have to be used with low cetanes (37-40) or cetane additive agents will be added to maintain the 50 cetane minimum, such as called for by the high speed Diesel engine manufacturers."

Predicts Small, Light Engines

For a long time after the war, high fuel taxes, especially for the automobile, will force cars to use small, light-weight engines using high octane gasoline, this authority believes.

To stimulate the increasing use of Diesel engines in railroad, marine, and air cargo transportation and in the construction field, Mr. Larson says it is up to the Diesel engineers to provide engines to operate on fuels of the lowest practicable cetane number, this to offset the practice of refiners cutting into their distillates to make high octane gasoline.

Two examples are cited in Mr. Larson's paper of how a conversion of a refinery to manufacture 100-octane gasoline reduces the supply of Diesel engine fuels. In the instance of a 55,000-bbl. refinery making 4000 bbls. of 100-octane gasoline (see Table 1) it is noted that the potential Diesel engine fuel supply has been cut from 9000 bbls.—mostly of 50 cetane fuel—to 5000 bbls. of 40-45 cetane distillate of 33 to 34 viscosity at 100 deg. F. "Had it not been for straight-run gas oil blending stocks at this refinery, the resulting distillate would be 37-40 cetane, or a tractor fuel of 50 cetane," the paper states. In another case (see Table 2) kerosine and distillate have given away even more drastically to 100-octane.

TABLE 1—Effect on Diesel Fuel Supply of Conversion of 55,000-Bbl. Refinery to Make 4000 Bbls. of 100-Octane Gasoline

	Bbls. Per Day Without 100-Oct. Gasoline	Produced With 100-Oct. Gasoline
Gasoline		
72-octane*	13,000	13,000
80-octane*	8,000	8,000
100-octane*	none	4,000
Kerosene (No. 1)	4,000	3,000
No. 2 Fuel	8,000**	5,000***
No. 4 Fuel	1,000****	none
Residual Fuel (Industrial)	20,000	20,000
Misc. and Gas	1,000	2,000

* Leaded
** (50-cetane)
*** (40-45-cetane)
**** (40-cetane)

TABLE 2—Effect on Kerosine and Distillate Yield of Conversion of 12,000-Bbl. Refinery to Produce 3000-Bbls. 100 octane Gasoline

	Bbls. Per Day Produced Without 100-Oct. Gasoline	With 100-Oct. Gasoline
Gasoline		
72 and 80 octane*	4,800	4,800
100-octane*	none	3,000
Kerosene and distillates	4,000	none
Residual fuels, asphalt, etc.	3,000	3,000
Gas		1,000

* Leaded value

Urge Full Gasoline Capacity At Mid-Continent Plants

NPN News Bureau

TULSA—Cooperative and farm bureau leaders in the Mid-Continent have wired Food Czar Chester Davis warning that "tractors will be standing idle on hundreds of farms before harvest is over this year unless immediate action is taken to remove present restrictions on refiners who normally supply central and north central states."

The wire, signed by Howard A. Cowden, North Kansas City, Mo., president of Consumers Cooperative Assn., and by managers, presidents and secretaries of several other cooperative organizations and farm groups, urged Davis to "please use your influence with PAW to break the log jam that is threatening operations on the vital food front."

"The bread basket of the nation," the wire said, "will fail in its job of producing food for freedom if its power farming equipment must stand idle. Same situation which kept tractors from rolling in Virginia and other eastern seaboard states recently will come to Kansas and Oklahoma inevitably unless all refiners in this area are required to return at once to maximum production of motor fuels."

Socony Reports Authority To Make Bead Catalyst

NPN News Bureau

NEW YORK—Authorization by the government to build a plant to manufacture its new bead catalyst (*see NPN, March 17, p. 18*) in large quantity was announced by Socony-Vacuum Oil Co., Inc., following the company's annual meeting here May 27.

"The TCC (Thermofor Catalytic Cracking) unit with the bead catalyst should result in a marked improvement in the quality of aviation gasoline," the announcement said, informing stockholders that the first of the 7 TCC units should be ready to operate in August.

VIGILANCE

THE statue of the "Minute Man" at Lexington immortalizes the first American Soldier. Yet it is not a martial figure. It shows us merely a country lad, clad in home-spun cloth, and armed with a squirrel gun. It shows us a man who, reared in the quiet of the New England countryside, was born and trained for peace — but who was all the more vigilant to defend it. And in this the "Minute Man" is the American of today — and his vigilance is ours, to defend the freedom, the peace and the right to happiness of thousands of Lexingtons and Concords.

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TRI-SURE PRODUCTS LIMITED, ST. CATHARINES, ONTARIO, CANADA

Tri-Sure

CLOSURES

How an Alky-Rubber Plant Works

Newsmen Get View of Institute, W. Va., Project Where Enough Rubber Will be Produced to Supply One-Seventh of Nation's Pre-War Demands

By NPN Staff Writer

INSTITUTE, W. Va.—For the edification of some 100 newspapermen, many of them technical writers, the government unveiled its alky-rubber plant here May 24-26.

The newsmen saw everything that could be seen of how the C-H molecules are heated and chilled and pressed and otherwise beaten around in this the largest of the government-owned synthetic rubber projects to start operations thus far.

At one end of the 40 acres of tanks, towers, heating units and such operated by the Carbide and Carbon Chemicals Co., they saw alcohol and benzol and ethylene go in, and at the other end of the 37½-acre copolymer plant operated by the U. S. Rubber Co., Buna S come out—pressed into 75-lb. loaves and cartoned for shipment on order by Rubber Reserve Co.

The scribes went through the plants from alky to Buna S under the care of members of the production and technical staffs, peeped through slits of glass into mixing tanks, teetered on expanded steel catwalks, and asked questions. They got straightforward answers on everything except military secrets. On these, there was some skidding. For instance, the answer on catalysts was "'let's say, miscellaneous chemicals."

Incidentally the place is amply guarded and blocked off, and complying with regulations the visitors emptied their pockets of matches before being admitted to some sections of the project. Officials take no chances on violations of the "no smoking" ban.

Although the complete process of turning out Buna S is carried on, some finishing touches remain to be done on a couple of units to put production into full swing. Much remains to be done on paving roadways and walks, but they're working on them.

Three of the 4 butadiene units are in production and one of the 2 styrene units. Work is nearly complete on the 2 remaining units.

Officials feel that good time has been made, inasmuch as construction started from scratch in April 1942 when the construction crews moved in.

The first large-scale alcohol-to-butadiene unit went into operation January 29, this year—2 months ahead of schedule. The first rubber emerged March 31, less than a year after the ground was broken.

Plant's Vital Statistics

For a few quick figures—

Cost of the plant complete will run around $56,000,000, and rated capacity is 90,000 long tons of Buna S a year—one-seventh of the pre-war consumption of all rubber in this country. Or in terms of passenger car tires, enough to equal 16,000,000.

The overall picture of the project is 3 huge plants. One plant of 4 units produces butadiene from alcohol, another consists of 2 units producing styrene from benzene, and the third is a unit of 3 copolymer plants.

The first 2 are operated for Rubber Reserve Co. by the Carbide people, the third by the U. S. Rubber Co., also for Rubber Reserve.

Rated capacity of the 4 butadiene units is 20,000 short tons a year each, or a total of 80,000. Each of the 2 styrene units is rated to produce 12,500 short tons a year.

The copolymer plant is composed of 3 identical units, each with a capacity of 30,000 long tons of rubber annually.

According to Kenneth Burgher, director of information for Rubber Director Jeffers, who sponsored the 3-day openhouse:

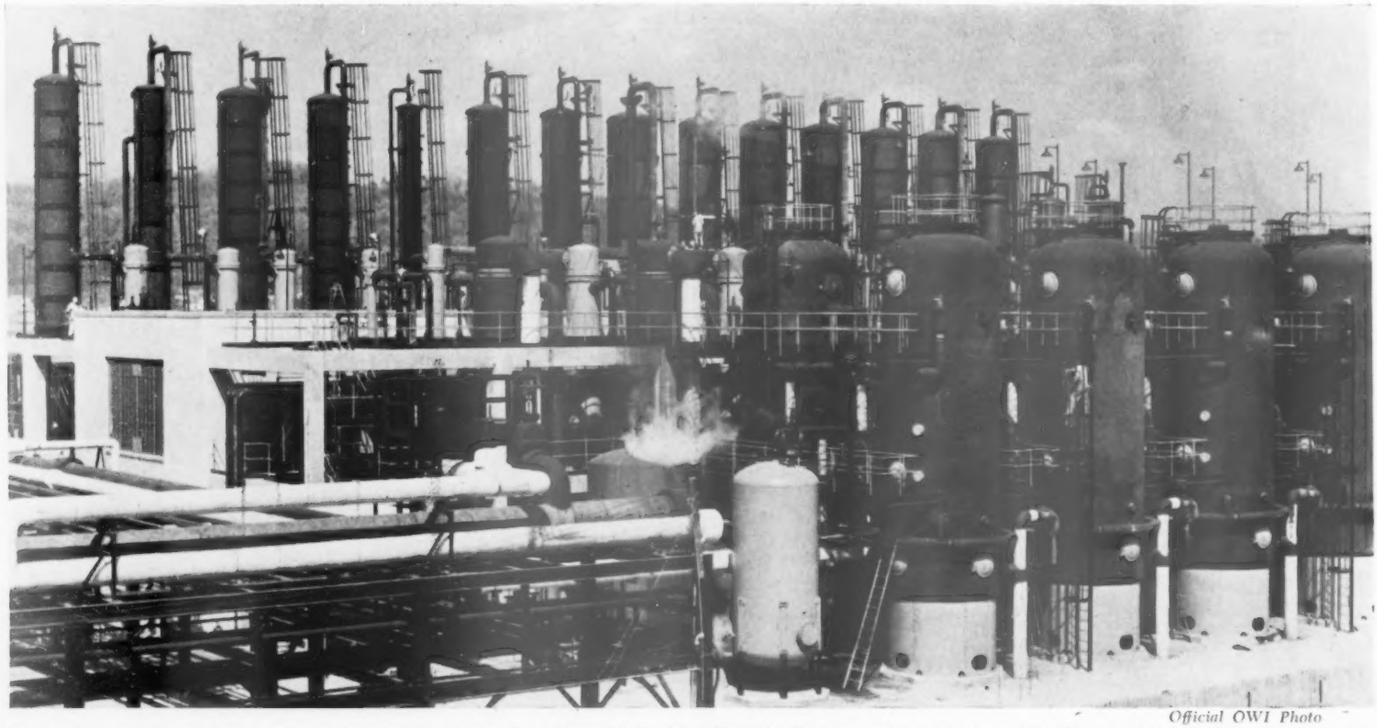
Has 4 of 11 Alky-Butadiene Units

"The alcohol method of making butadiene, of which the Institute plant has 4 out of the 11 units, will be used in making about one-third of the country's butadiene requirements. It was employed in the rubber program because of the certainty with which plants of this type could be constructed and brought into production. For this plant and others like it, it is expected to use alcohol derived from the fermentation of grain.

"However, the alcohol required for this process could theoretically be obtained from many sources—from the fermentation of grain, potatoes, sugar, molasses, or other carbohydrates. Or, synthetically from natural gas, refinery gas or petroleum. The end result is the same—high purity butadiene."

The alcohol used at Institute is 190 proof and denatured to meet government requirements. It is shipped to the plant by railway tank cars and by barge and stored in tanks having a total capacity of 7,500,000 gal.

The alcohol's first step is to a series of converters, where heat and special catalysts con-



Official OWI Photo

General view of one of the 4 butadiene units at the Carbide and Carbon Chemicals Corp. plant, Institute, W. Va. At right, in first row, are converters where the processing of grain alcohol into butadiene is started. Row of distillation tanks, where butadiene is purified, is in rear

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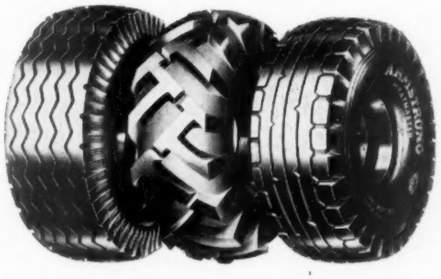

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If you are an Independent tire distributor or dealer, the Armstrong Plan—on every count—is the right one for you. It puts you in a position to make the most of every opportunity to improve your sales and profits. It meets fully your requirements today and will give your business the soundest possible basis for continued success when peace comes. As an Armstrong Independent you have—

THE RIGHT SUPPLIER—The Armstrong system of distribution is organized for the sole purpose of giving the fullest possible backing to Independents with no burdensome conditions and restrictions. It has helped thousands of Independents to prosper and grow strong.

THE RIGHT DISCOUNT SETUP—You realize a full and generous profit on every sale *at once*—because Armstrong gives you the *lowest net discount* AT THE TIME OF PURCHASE.

THE RIGHT TIRES AND MATERIALS—You know that Armstrong tires enjoy a well earned reputation for long, rubber-saving mileage—a prime sales asset today. You can depend equally on the excellence of Armstrong's fine line of camelback and repair materials.

THE RIGHT PROTECTION—Armstrong's Square Deal policy is a bulwark of strength for Independents. It bars all "inside" arrangements—it permits no raiding—no company stores. Armstrong dealers and distributors are really independent proprietors with fully protected sales rights.

THE RIGHT GUARANTEE—Every sale of an Armstrong tire is covered by a written Road Hazard Guarantee of pre-war strength.

THE RIGHT PLAN—Because the Armstrong plan for Independents has been developed, tested and kept up to the minute for three decades, its basic soundness has stood up under the stress of every war emergency. So that you may judge how well it fits your needs—

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of the Armstrong Plan for Independents

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General Offices and Plant — WEST HAVEN, CONN.

Southern Plant — The Armstrong Tire & Rubber Co., Natchez, Miss.

ARMSTRONG PASSENGER CAR AND TRUCK TIRES

vert a part of it to butadiene. Unreacted alcohol and intermediate products are removed for recycling through the converters in a recovering system consisting of a number of distillation towers and scrubbers.

The butadiene is purified by distilling and washing it until it is over the 98.5% purity specified by Rubber Reserve.

Butadiene is handled under pressure to keep it in a liquid state. The purified butadiene is stored in pressure tanks for delivery to the copolymer plant by pipe.

Before the copolymer plant went into action, much of the output at Institute was shipped to rubber plants in other parts of the country in special pressure tank cars.

The ethylene used at the plant is produced from refinery gases at Carbide's plant at South Charleston, 5 miles away.

How Styrene is Made

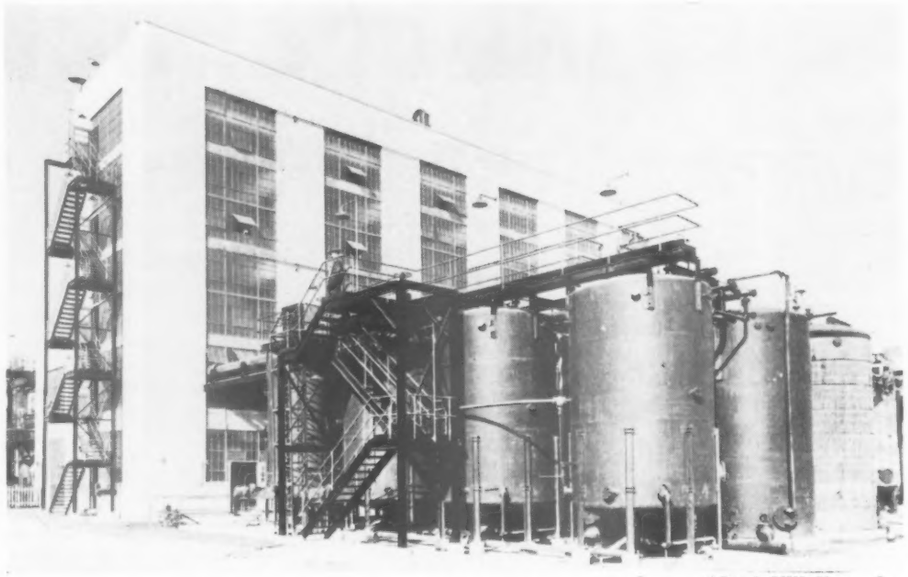
For making the styrene, benzol and ethylene are passed over a catalyst in a reactor called an alkylator where ethylbenzene is formed.

The ethylbenzene is removed in a series of fractionating columns and held in intermediate storage tanks. From these it goes to a second set of reactors. Two hydrogen atoms are removed and you have styrene, which now has to be purified to bring it up to the required 99% purity.

Like the butadiene, the styrene is piped to the copolymer plant.

At this point, the visitor feels he's on the threshold of something really mysterious. In the copolymer plant, however, he has a chance to see what's going on in some of the tanks along the way by peeping through little glass windows.

In one tank he sees a milky liquid, which he is told consists of approximately 3 parts of butadiene, 1 part of styrene and 7 parts of soapy water. He learns this is called latex and that the tiny droplets of butadiene and styrene are held in suspension just as in milk the particles of butterfat are dispersed in water.



Official OWI Photo

This unit at the Carbide and Carbon Chemicals Corp. synthetic rubber plant, Institute, W. Va., produces styrene, the chemical which when polymerized with butadiene produces Buna rubber

He peeps into a glass-lined tank farther on. Here the copolymerizing is taking place. Heat has been applied and a catalyst added. The droplets are stirred under pressure until they change into solid rubberlike particles of Buna S.

Some of the butadiene and styrene don't get together, so this residue boiled off and recovered for another try. The latex, still milky, now contains tiny rubber particles instead of droplets.

Salt and acid now are added to bring the particles together into a sort of curd, which is screened and washed. The process now is open to full view. All that remains is to squeeze and dry the water out and press the crumbles of Buna S into 75 lb. loaves in an automatic baler and put them into cardboard cartons for storing and shipping.

More Vital Statistics

Here are some operating items the plant consumes:

120,000 gal. of water a minute—enough to supply a city the size of Los Angeles.

14,400 kilowatts of electricity—more than half the electrical generation of the state of Delaware.

7700 tons of coal a week.

6595 linear feet of waste disposal piping—a sewerage system for a large town.

As to the manpower question—Institute hasn't had too much trouble in obtaining trained and technical men. When operating at full capacity it will have about 1250 employes. It is practically fully staffed now.

They don't believe in picking their men blind. A man must not only know his job but he must have personality and an ability to get along with the rest of the people.

They are reaching out into the colleges and earmarking likely young men who will fit into the organization. This is done by personally visiting the colleges and interviewing prospects.

Some members of the staff have come by way of the U. S. Employment Service, but personnel officials are not depending on this source entirely.

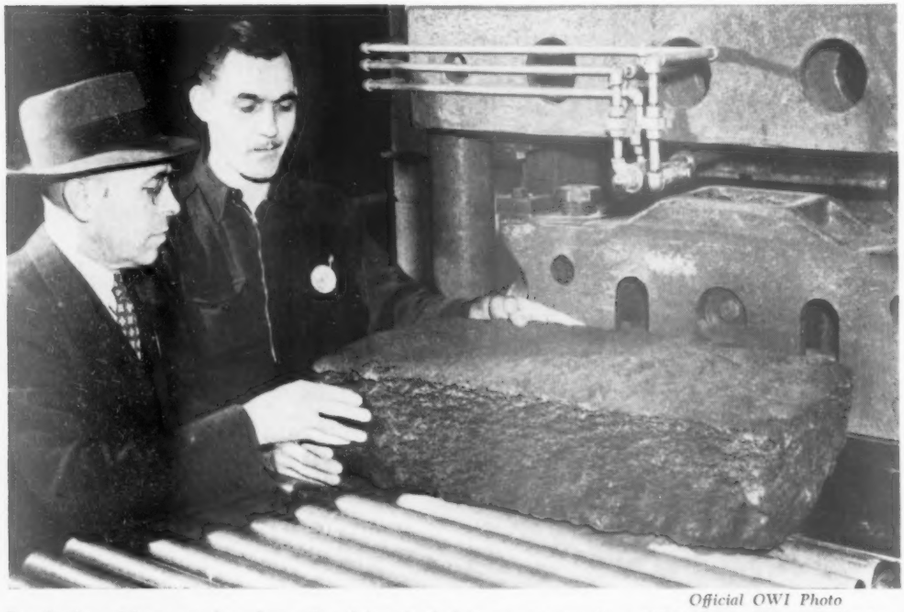
Less than 15% Technically Trained

The major part of the work at Institute is conducted by trained workmen. Less than 15% are technically trained men.

Officials of both Carbide and U. S. Rubber look to the postwar prospects of synthetic rubber with confidence. They feel synthetic rubber will be in a position to hold its own in competition with imports of natural rubber.

According to Chief Engineer F. S. Cooper, Jr., of U. S. Rubber:

"It took 30 years to develop natural rubber for the varied uses we put it to. We've only been working with GRS 18 months. Give us 12 months more."



Official OWI Photo

Synthetic rubber, coming from the drier, is fed to an automatic weighing machine which delivers 75-lb. hunks of material to the bailer at the plant operated by United States Rubber Co.

Accent on EXPERIENCE

"Restore to me youth, but let me retain the experience of my threescore years of maturity—and I will build a new world."

THE sage who said that lived in an era when much of a man's knowledge died with him . . . when progress moved slowly under the uncertainty of continual trial-and-error.

Today, through data, records and corporate entities, experience is cumulative. Far more complete. Infinitely more reliable. Helpfully available to posterity. It has fewer lapses or loose ends. It protects against pitfalls.

This is signally true of Badger. A century of unbroken experience is a Badger heritage of inestimable value to advancing enterprise. Steeped in this background, yet imbued with youthful vision and energy, is a living generation of Badger chemists and engineers.

Badger is an organization of specialists who know how to take a "pilot-proved" process and clothe it with the proper equipment for practical commercial production.

It is a group of trained minds who can master the problems possibly unimportant in pilot-plant tests but which (like flow, heat, pressure, corrosion and chemical reactions) are vital in the successful operation of a full-fledged producing plant.

Long and *broad* experience in such matters is one of the reasons why Badger engineering is being entrusted with the designing, and the complete construction to the point of efficient operation, of new plants for the production of butadiene, high-octane gasoline, high-power explosives, alcohols and other products of today's and tomorrow's petroleum, petro-chemical and chemical industries.

It is also a reason why Badger is called on more and more to undertake new-plant construction or old-plant conversion *in co-operation with operating companies.*

Badger experience and facilities are worth keeping in mind when looking toward *your* post-war plans.

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Oil TRANSPORTATION

ICC Reconsiders Okay On Deal Involving Refiners Transport

NPN News Bureau

WASHINGTON—Full membership of Interstate Commerce Commission on May 28 heard pro and con arguments on:

Is the Union Tank Car Co., through its 82% stock ownership of Refiners Transport & Terminal Co., large mid-western petroleum transporter, aiming to invade the oil trucking field from Maine to Florida by acquiring assets of independent transporters or is U.T.L. simply an investor in R.T.T. exercising no management control over the trucker?

The question came up on ICC's reconsideration of majority opinion in ICC Division 4's decision approving the purchase by R.T.T. of assets of Marshall Transport Co., Inc., Glen Burnie, Md., operating in the Middle Atlantic States. R.T.T. has before ICC 5 other applications to buy assets of for-hire transporters operating along the Eastern Seaboard.

Transporters Intervene

Two southeastern transporters, Petroleum Carriers, Jacksonville, Fla., and Walker Hauling Co., Atlanta, represented by Martin Sack, Jacksonville, intervened in the argument because R.T.T. has applied to buy Motor Fuels Transport, Inc., Jacksonville.

Mr. Sack contended that if the tank car company is made a party in the case, then it will be subject to ICC and have to report on its tank car rental contracts with oil company shippers. Such rentals are now outside ICC's jurisdiction.

"What we fear," said Mr. Sack, "is that the tank car company may try to build up its truck business from Maine to Florida by a half-cent cut in its tank car rentals on mid-western hauls for the same oil companies."

Robert W. Winter, representing R.T.T., denied that the tank car company had "fathered" the Marshall purchase. He said the tank car company was simply an investor in R.T.T., with only 1 director out of 5 on the board. He ridiculed the idea that it might make a "deal" on tank car rentals.

Answering contentions that R.T.T. had "partially consummated" the Marshall deal without ICC approval, Mr. Winter said it was their duty as a common carrier and American citizen to have bought 10 trucks from Marshall because these units, idle in the East, were badly needed in the Mid-West.

Charles E. Cotterell and Harold G. Hernly, representing Coastal Tank Lines, Inc., Leaman Transportation, and other eastern truckers, also argued that ICC reconsider approval of the R.T.T.-Marshall deal.

A Justice Department representative appeared, explained that the department's lawyer handling the case was trying another case at Pittsburgh. He contented himself with filing again the reconsideration petition.

New Rate-Weight for Gasoline?

ICC May be Opening Door in Ordering Establishment of 4.7 lbs. per Gal. for Liquefied Gas from Mid-Continent into Southern Territory

NPN News Bureau

WASHINGTON—In a decision which may open the door to reconsideration of estimated weights on other petroleum products, such as gasoline, ICC has ordered that estimated weight for liquefied petroleum gas not exceed 4.7 lbs. per gal. for freight purposes from mid-continent fields to southern territory. The former estimated weight was 6.6 lbs. per gal.

In a decision May 15, ICC ordered that the defendants in the case, designated as No. 28663, Green's Fuel Inc. vs. Atlanta & St. Andrews Bay Railway Co. et al, establish on or before Aug. 30, 1943 and maintain after that an estimated weight not to exceed 4.7 lbs. per gal. on liquefied petroleum gas. The case was submitted last Aug. 3.

Although the complainants assailed the freight charges for the transportation of liquefied gas, the report stated, their main grievance was with respect to use of the weight of 6.6 lbs. per gal. in computing these charges.

That figure, the report pointed out, is not an estimated weight of liquefied gas, but is used in computing freight charges on gasoline and other commodities in the group of refined oil products.

Weights of Liquefied Gases

Butane weighs 4.85 lbs. isobutane 4.72 lbs. and propane 4.24 lbs. per gal. at 60 deg. F. The weighted average of these gases, based on 1939 sales in the U. S., is 4.62 lbs. per gal., the report added. When combined in the proportions generally used for commercial butane gas, the weight does not average over 4.7 lbs.

Some of the complainants had also asked reparation on past shipments. The commission, however, said that for several reasons the estimated weight of 6.6 lbs. seemed not to have been unreasonable in the past.

The Commission's report also embraced Docket No. 28696, Butane Gas Dealers of Mississippi et al vs. Atchison, Topeka and Santa Fe Railway Co. et al; No. 28696 (Sub. No. 1) Georgia Automatic Gas Co., Inc., et al vs. Atlanta, Birmingham and Coast Railroad Co. et al; No. 28756, W. G. Petty & Son et al vs. Atchison, Topeka and Santa Fe Railway Co., et al; and No. 28790, R. C. Weis, DBA Weis Butane Gas Co., vs. Chicago, Rock Island and Pacific Railway Co. (Frank O. Lowden, James E. Gorman, and Joseph B. Fleming, trustees) et al.

The ICC report pointed out that although vapors of LPG are highly inflammable, handling the gas is no more hazardous than handling gasoline due to equipment used and observance of the prescribed safety regulations. Further, no claims for loss or damage have resulted.

Subject to classification Rule 35, which applies to freight shipped in tank cars, liquefied gas is rated 4th class, minimum 32,000 lbs., in the western and southern classifications. That rating is 55% of first class.

In 1928, the report said, in accordance with an understanding between the railroads and the shippers of petroleum products that the revenue per car for its transportation should be the same as that derived from corresponding movement of gasoline, this gas was grouped with gasoline and other refined oils, which move on commodity rates lower than the class rates and at an estimated weight of 6.6 lbs. per gal. Rule 35, the report added, therefore has no application. Gasoline and other refined oil are rated 5th class, which is 45% of first class in the South and 37.7% of first class in the Southwest.

Florida Bill Would Put State in Business Of Transporting Oil

Special to NPN

JACKSONVILLE, Fla.—Florida oil men are being called to action to combat a bill (S. 403) introduced by Sen. Earnest Graham and already passed by the Florida Senate which would authorize the State Road Department to engage in the business of transporting, for hire, gasoline and other petroleum products upon certification by the governor.

The bill also authorizes the State Road Department to purchase and lease all necessary motor vehicles, storage tanks, pipelines and other equipment needed to carry on the business of transporting and storing petroleum products.

Section One of the bill provides:

"The State Road Department, upon certification of necessity therefor by the governor of the State of Florida be, and it is hereby authorized and empowered to engage in the transportation for hire from any point without the State of Florida to any point within the State of Florida, and from any point in the State of Florida to any other point in this State, of gasoline, fuel oil and other products of petroleum for any person, firm or corporation, association of persons within the State and for any county, municipality, district or political unit or subdivision in the State, or for any Officer, Board, Commission or Agency of the State of Florida."

Florida Petroleum Industries Committee reports that, to its knowledge, this bill is the first of its kind proposed in any state.

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But—production schedules are hard things to control these days—especially in a business like ours where the types of work we do are so varied. Despite the most careful planning, there are times when some departments get ahead of schedule while others are hard pressed to meet demands. And a week later the situation may be reversed.

Because of this condition, we are sometimes able to accept new orders for early production. Thus, we may be able to immediately handle your requirement. Of course, much would depend upon the CMP allotment this requirement would carry.

Don't take it for granted that you can't get what you need. First, mail us your specifications and prints. We will quote at once and advise you of the earliest possible production and delivery dates. You may be agreeably surprised.

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Keying Oil Transport to War

District 2 Transportation Committee Reports on Progress, Telling of Proposals it Made and How They Increased Oil Transport Efficiency

NPN News Bureau

CHICAGO—Further improvement of Great Lakes terminals and harbors, construction and conversion of additional barge equipment with training of inland waterways personnel, and more trades and exchanges of products plus greater perfection of tank truck distribution within District 2 are in the program of the District 2 transportation committee as shown in a progress report just released.

The report reviews the history and activities of the committee from its inception on July 24, 1941, to date.

Millions of additional barrels of oil in various forms have reached the East through the incessant efforts of the committee. Maximum efficient operation of tank cars, barges, lake tankers, new loops in pipelines and the utilization of truck transports within District 2 have resulted in a most complete revolution of transportation within the area.

The District 2 committee initiated full train loads of tank cars, traveling symbol routes and made many other recommendations that were later put into orders and directives by the Office of Defense Transportation and Petroleum Administration for War, the report said, resulting in consolidated traffic and greatly facilitated movement of vital petroleum. Important among the trades suggested are those with Canadian companies on the Great Lakes to off-set Canada's loss of imports by ocean tanker from our Gulf Coast and South America.

Helped Release Cars

Soon after the Transportation Committee was organized, the report shows, a survey revealed that 37,358 tank cars were in service from origins in District 2, exclusive of liquified petroleum gas, railroad owned, government owned, narrow gauge cars and cars in service to District 1. The survey also disclosed that a large portion of the tank car load in District 2 could be handled by truck, and since that first survey a total of 24,177 tank cars out of the 37,358 have been made available for hauls to District 1.

Working toward accomplishment of this, at the third meeting of the transportation committee, held in Chicago Sept. 16, 1941, a subcommittee on tank cars and trucks proposed numerous measures designed to increase tank car efficiency.

These recommendations were adopted and eventually expressed in orders issued by PAW and ODT, the progress report shows. Next, cars of less than 7000 gal. capacity were withdrawn from long hauls and larger cars substituted to increase the volume of products delivered to the East.

District 2's Cars Small

"It is pertinent to note in this connection," the committee points out, "that 5019 of the (13,181) cars remaining in service in District 2 as of March 1, 1943, were of less than 7000 gal. capacity each."

But tank cars and trucks were not the whole answer to the problem. The Transportation Committee brought forth a new plan on March 24, 1942. It recognized that oil supplies in District 1 were below a normal and safe level, with no prospect of increase unless transportation facilities still located within District 2 were made available. The committee proposed a broad program calling for pipeline reversals, increased efficiency at pipeline and water terminals, etc.

"Since formulation of this plan, the transportation and supply and distribution committees have been constantly at work perfecting and developing it," the committee said.

Helped Hike Lakes Hauls

Great Lakes tankers during 1941 delivered less than 7000 b/d eastward for there was little need of it, the committee report said. However, war changed this almost completely and in 1942 an average of 56,000 b/d was delivered into District 1 from Great Lakes ports in District 2 by re-arrangement of tanker schedules. The committee made continuous studies of equipment needs, harbor terminal facilities and time saving by increasing loading and unloading rates of terminals, providing greater water depths at docks, improving bunkering and ballast facilities. Terminals at East Chicago, Toledo, Cleveland and Buffalo received particular attention in committee recommendations, some of which have been carried out but others not yet undertaken.

Sees Greater Efficiency

Trades, exchanges and sales of products practically eliminated cross-hauls and back-hauls on the Great Lakes by the end of the 1942 season, with further work being done during the closed season just passed which the committee expects will result in still greater efficiency during 1943.

Users of lake carriers were not admitted to the eastern "pool" for reimbursement of excess costs until Aug. 1, 1942, which admittance was at request of the District 2 subcommittee. This arrangement made available more vessels from the Eastern Seaboard, increasing the total haul, including movement to Canadian lake ports to replace imports from Gulf Coast and South American ports.

"Recommendations have now been made with a view to effecting exchanges with Canadian companies of both boat time and petroleum and petroleum products," the committee said, "which if completed will result in increased efficiency for American vessels as well as Canadian."

Worked to Up Barge Hauls

Inland waterway barges on the Mississippi and Ohio systems are contributing greatly to the overall increased movement into District 1, the District 2 committee states, although direct barge shipments into District 1 are comparatively small. The barges deliver products to the river terminals, where they are picked up and distributed locally by tank trucks, releasing a large number of tank cars for District 1 service.

Movement of all barges is reported daily to the Joint Barge Subcommittee for Districts 1, 2 and 3, composed of 2 members from each district, which began functioning as successor to the temporary shallow draft marine subcommittee for District 2, shortly after July 1, 1942. Monthly barge reports are compiled and made available to PAW, ODT, industry committees and the U. S. Coast Guard in maintaining an efficient operation.

Cross-hauls and back-hauls are limited to necessity with the assistance of ODT.

Suggested Shifting Barges

Another shifting of barges to correlate supply and distribution occurred just before the close of the 1942 navigation season, when a large amount of equipment was taken from service on the lower Mississippi and Ohio rivers and moved into the Minneapolis-St. Paul area.

"The committee early recognized that to secure substantial increase in the movement of petroleum products by barge," the progress report sets forth, "it would be necessary to add to the inland waterways fleet. Comprehensive, detailed plans were developed and presented to the Petroleum Administrator for War for both the construction and conversion of barges and towing power. These plans contributed greatly toward the construction and conversion programs later adopted as result of which the potential of the inland waterways is steadily increasing."

Tank Cars Haul 847,768 b/d During Week

NPN News Bureau

WASHINGTON— Tank car hauls of crude and products averaged 884,768 b/d during the week ended May 22, compared with 980,326 b/d the previous week—a drop of 9.7%, PAW reported May 27.

A total of 50 participating oil companies loaded 28,708 tank cars as follows:

Company	Cars	Company	Cars	Company	Cars
Allied	87	Freedom Oil	4	Roosevelt Oil	2
American Bitumuls	15	Frontier Oil	32	Royal Petroleum	127
Amsco	292	Globe Oil	73	Shell	1441
Arkansas Fuel Oil	79	Gulf	2814	Sinclair	2475
Ashland Refining	114	Hartol	313	Socony-Vacuum	3095
Asiatic	15	Home Oil	16	S.O. California	9
Atlantic Refining	2533	Jenny Mnfg. Co.	17	S.O. Kentucky	79
Bell Oil & Gas	8	Maritime Oil	30	S.O. New Jersey	4309
James B. Berry Sons	5	Old Dutch	5	S.O. Ohio	145
Cantelow	19	Pacific Oil	25	Sun	2605
Chalmette	36	Pan-American	2097	Talco	24
Cities Service	1093	Petrol Corp.	136	Taylor Refining	85
Continental	244	Petroleum Heat & Power	7	Texaco	2513
Crown Central	23	Phillips	154	Tide Water	958
Daugherty	15	Premier Oil	17	Southport	221
Deblois	35	Pure	67	Miscellaneous	75
Elk Refining	28	Republic Oil	87		

The Texas Company's policy of many years' standing is to make its patents and inventions available to the petroleum industry at prices that are reasonable.

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Address:

TEXACO DEVELOPMENT CORPORATION

A subsidiary of The Texas Company

26 Journal Square · Jersey City, N. J.

Wartime Farmer is Big Consumer of Oil

Agriculture—A War Industry—Will Consume More Oil Products In '43 Because Older Equipment Must Work Harder—and Longer

PURCHASE ORDER

3,170,640,175 Gallons of Gasoline

491,104,500 Gallons of Fuel Oil

448,711,000 Gallons of Kerosine

40,110,600 Gallons of Lubricating Oil

92,833,600 Pounds of Greases

That's the major part of the bill of goods the oil industry will deliver to American farmers in 1943—to farmers who must produce more food for war in spite of manpower shortages, in spite of late planting, in spite of weather, in spite of the inability to replace old machinery and equipment at normal, peacetime rates.

This bill of goods does not include the motor oil requirements of farm tractors, which are estimated at 40 gal. per tractor for the year. It does not include the complete oil products requirements for stationary and portable power units such as combines, sprayers, dusters, balers, milk coolers, milking machines, cream separators, grading machines, feed grinding machinery, farm saw mills, farm elevators, cotton gins, and threshing machines. Other equipment—like orchard heaters, incubators, brooders, hay or tobacco dryers, and greenhouse equipment—will also need oil products in addition to the initial order shown above.

Petroleum products as employed by farmers may be divided according to use into the following 5 groups:

1—Gasoline, used in tractors, farm automobiles, and farm trucks. Gasoline is also used in the household and in the pumps required to supply water for irrigating farm lands.

2—Lubricating Oils, used in all tractors, trucks, automobiles, irrigation pumps, and in other farm machinery.

3—Distillate Fuel Oils, used in oil burners for heating systems and also used in some tractors and irrigation pumps.

4—Kerosine, used in certain types of tractors, in farm household appliances such as cook stoves, hot water heaters, kerosine refrigerators, and lamps and lanterns.

5—Greases, used in farm machinery.

The 1943 requirements for petroleum products for farms given in the following tables are estimated by the Agriculture Department. No comparison of these estimates with consumption of oil products in earlier years is possible.

"The validity of the estimates", says the Department, "is limited not only by lack of existing data, but also by future government policies. For example, it is assumed that agricultural requirements for gasoline will remain unchanged from past consumption levels as long as farmers are specifically exempted from the regulation of trucks by the Office of Defense Transportation and farm passenger cars are generally accorded 'C' books by the local ration boards.

"There should be some reduction in gasoline requirements, however, as the result of conservation programs such as voluntary farm 'carpools', cooperative or mutual farm trucking arrangements, and farmer use of existing Joint Information Offices established under the auspices of ODT.

"Also, estimates of future gasoline requirements for farm trucks and automobiles are bound to be influenced greatly by the national rubber program and by the policy of allocating replacement parts and repair equipment necessary to the maintenance of motor vehicles. Yet, recognizing the uncertainty of future public policy and the exigencies of war, the future must be judged by reference to the past. Hence the estimates for 1943 rely largely upon requirements in the immediate past."

NATIONAL PETROLEUM NEWS herewith publishes the estimates of petroleum requirements for farm trucks, tractors and passenger cars. Lubricating oil requirements for tractors are not shown in the tables, but can be quickly computed for any state on the basis of 40 gal. per tractor for the year.

It should also be noted that Agriculture Department at the present time has increased its estimates of gasoline needs for tractors by 10% of the figures shown in Table 2. This now brings the estimated total gasoline requirements for tractors to 1,176,100,000 gal. to allow for the recent increases in food production goals.

Farm tractors this year will consume almost as much gasoline as farm-owned passenger cars

Table 1—Truck & Auto Use by Farmers, 1943

(Estimated by Dept. of Agriculture)

	Farm Autos		Farm Trucks	
	Average Annual Mileage†	Average Miles Per Gal. 'Gas'†	Average Annual Mileage	Average Miles Per Gal. 'Gas'
DISTRICT 1				
Conn.	4,896	16.2	6,993	10.8
Del.	4,896	16.2	4,336	
Fla.	4,896	16.2	6,163	12.9
Ga.	4,208	14.8	5,421	12.9
Me.	4,896	16.2	6,091	11.3
Md.	4,896	16.2	5,862	11.4
Mass.	4,896	16.2	4,336	...
N. H.	4,896	16.2	4,336	...
N. J.	6,925	15.6	4,336	...
N. Y.	4,896	16.2	4,336	...
N. C.	5,104	16.9	6,527	11.4
Pa.	4,679	15.8	5,669	11.3
R. I.	4,896	16.2	4,336	
S. C.	5,124	16.9	6,342	11.1
Vt.	4,703	16.2	7,200	10.0
Va.	4,896	16.2	3,404	12.0
W. Va.	4,896	16.2	3,648	12.6
DISTRICT 2				
Ill.	5,639	16.4	4,246	11.4
Ind.	5,539	16.4	4,994	11.2
Iowa	5,605	16.2	4,354	11.7
Kans.	7,219	16.2	4,163	11.6
Ky.	5,605	16.2	8,031	12.1
Mich.	5,018	16.0	5,366	11.6
Minn.	5,605	16.2	3,311	11.5
Mo.	5,605	16.2	6,434	11.4
Nebr.	5,605	16.2	2,342	7.6
N. D.	7,219	16.2	2,219	11.4
Ohio	4,679	15.8	6,529	13.5
Okla.	5,605	16.2	4,275	12.4
S. D.	5,637	17.2	3,222	13.1
Tenn.	5,605	16.2	7,904	12.6
Wisc.	5,018	16.0	2,501	12.7
DISTRICT 3				
Ala.	4,500	16.0	7,799	12.8
Ark.	4,500	16.0	5,369	12.8
La.	5,000	16.0	4,629	12.9
Miss.	°4,208	14.8	5,018	11.7
N. M.	5,000	16.0	6,224	12.9
Texas	5,000	16.0	3,802	14.4
DISTRICT 4				
Colo.	§5,637	17.2	4,297	11.9
Idaho	5,637	17.2	4,615	12.0
Mont.	§5,637	17.2	4,081	11.4
Utah	5,637	17.2	5,932	11.8
Wyo.	5,637	17.2	5,700	10.8
DISTRICT 5				
Ariz.	7,363	16.9	6,555	15.5
Calif.	9,276	15.9	6,809	10.9
Nev.	7,363	16.9	5,592	14.6
Ore.	‡6,835	17.1	2,211	7.4
Wash.	‡6,105	17.4	6,496	10.2

† Monroe, Day, Brady, Dorothy S., Constantine, June F. and Benson, Karl L., *Family Expenditures for Automobiles and Other Transportation*, U. S. Dept. Agri., Misc. Pub. No. 415, 1941 pp. 153-7 (Average Quantities of Gasoline and Oil for Family and Business Use: Farms in 23 States for period 1935-36. Table No. 43, Columns 8-9.

° Miss. reported 4208 average miles per year; this figure appears to be low for Texas and for District 2 as a whole.

§ Col. and Mont. (447 samples) reported only 4 gal. per year: not representative, therefore increased.

‡ Ore. and Wash. reported jointly, with additional samples from Ore. "part-time" farmers.

ANNUAL REQUIREMENTS

The estimated requirements for petroleum products to be used on farms during 1943 are as follows:

1—**Gasoline**—An estimated total of 3,170,640,175 gal., consisting of 1,406,981,300 gal. for farm automobiles; 1,176,100,000 gal. for tractors; 467,082,000 gal. for farm trucks (defined as privately-owned vehicles not used for commercial purposes such as "over-the-road" common or contract carrier operations; also "for-hire" trucks hauling agricultural products

would not be included); 64,549,875 gal. for farm irrigation pumps and 55,927,000 gal. for farm household equipment.

2—**Fuel Oil**—An estimated total of 491,104,500 gal., consisting of 406,513,000 gal. for tractors; 63,076,600 gal. for oil-heated farm dwellings; and 21,514,900 gal. for irrigation pumps.

3—**Kerosine**—An estimated total of 448,711,000 gal., consisting of 336,317,000 gal. for farm household purposes and 112,394,000 gal. for certain types of tractors.

4—**Lubricating Oil**—An estimated total of 40,110,560 gal., consisting of 26,579,000 gal. for farm automobiles, and the balance for use in farm trucks and irrigation pumps.

5—**Greases**—An estimated total of 92,833,500 lbs. for use in farm automobiles, tractors and equipment, farm trucks and irrigation pumps.

The tables which follow show these estimates by state, and by type of equipment.

CONCENTRATION IN DISTRICT 2

With the exception of gasoline use by farm irrigation pumps in the Pacific Coast area and in the Southwest, there is a decided geographical concentration of requirement for petroleum products for farms in the 15 states which comprise PAW District 2.

This district requires more petroleum products than any other area, and in some instances more than the other districts put together. Exactly two-thirds of the total number of tractors, well over one-half of the total registration of automobiles owned by farmers, nearly one-half of fuel oil burners installed in farm dwellings, and over two-fifths of the total number of private farm trucks are found in these 15 states.

ANNUAL MILEAGE

Petroleum marketing companies, which serve a limited area, will find the table (Table 1), estimating average annual mileage and miles per gallon for farm trucks and farm automobiles, particularly useful in determining the amount of petroleum products his farm customers will require (*See NPN's digest of census data, May* 12, *p.* 35). Farm needs for petroleum products rate top priority where limited supplies are being allocated by petroleum suppliers.

Since the requirements for oil products vary by season, Agriculture Department has developed tables of estimates of percentages and quarterly requirements for each state. These will be published in the June 9 issue of NATIONAL PETROLEUM NEWS with other agricultural requirements of oil products used by electric pumps, and internal combustion pumps for irrigation (by states); with farm household requirements of kerosine and gasoline (by states); and other requirements for oil products by PAW Districts.

As the estimates indicate, the oil industry has a big, essential wartime customer to serve in the farm industry. Since older farm machinery must work harder and work longer in 1943 (*see NPN May* 12, *p.* 33) the oil industry's contact with farmers also carries the responsibility of keeping farm machinery on the job through the proper application of petroleum products.

To meet this responsibility the Petroleum Administrator has pledged the industry to work with the farm administration and WPB to keep farm machinery in tip-top condition.

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TABLE 2—PETROLEUM REQUIREMENTS OF FARM EQUIPMENT, 1943

(Estimated by U. S. Department of Agriculture)

	FARM AUTOMOBILES			FARM MOTOR TRUCKS			FARM TRACTORS			
	Gasoline Gallons	Lube Oil Gallons	Grease†† 1000 Lbs.	Gasoline 1000 Gal.	Lube Oil Gallons	Grease† 1000 Lbs.	Gasoline 1000 Gal.	Kerosine 1000 Gal.	Other Fuel 1000 Gal.	Grease‡ 1000 Lbs.
DISTRICT 1										
°New England States	.....	.....	...	.....	.....	...	12,590	3,096	654	550
D. C.	.....	.....	...	17	200	...	.....	.....	.....	...
Conn.	8,687,700	110,000	209	7,096	85,600	275	.....	.....	.....	...
Del.	2,467,200	48,000	35	924	12,300	64	2,278	0	170	2
Fla.	8,278,200	160,000	57	6,878	92,700	359	1,470	455	3,532	139
Ga.	21,905,000	439,000	136	9,068	122,000	542	1,198	407	5,082	171
Me.	7,718,200	149,000	274	7,122	88,900	328	.....	.....	.....	...
Md.	11,739,900	227,000	208	6,725	85,600	326	7,076	315	383	186
Mass.	7,172,400	139,000	273	4,487	59,600	312	.....	.....	.....	...
N. H.	3,898,700	75,000	136	3,493	30,900	162	.....	.....	.....	...
N. J.	10,752,600	189,000	150	6,158	81,700	428	10,773	596	477	238
N. Y.	42,222,800	817,000	952	27,532	264,100	1,382	39,110	4,117	2,258	1,062
N. C.	38,497,800	637,000	194	11,754	148,900	516	4,256	1,995	399	213
Pa.	46,780,200	948,000	872	22,073	330,000	1,108	14,470	9,080	6,604	1,016
R. I.	871,200	17,000	24	714	9,500	50	.....	.....	.....	...
S. C.	19,299,600	318,000	68	4,698	57,700	206	405	2,495	475	86
Vt.	5,219,300	86,000	177	4,450	49,400	154	.....	.....	.....	...
Va.	26,226,400	508,000	420	6,609	87,900	582	6,908	503	1,109	206
W. Va.	11,499,000	223,000	325	3,609	64,000	311	1,240	460	.....	64
DISTRICT 2										
Ill.	71,104,400	1,369,000	1,691	15,816	198,400	1,063	93,509	6,403	28,142	2,382
Ind.	58,415,700	1,168,000	1,339	13,290	134,200	743	46,644	3,780	11,854	1,374
Iowa	81,863,900	1,538,000	2,273	9,856	125,900	659	88,531	2,459	31,970	2,459
Kans.	67,019,600	1,354,000	1,275	15,300	162,700	1,065	125,490	1,495	27,875	1,709
Ky.	34,149,900	666,000	638	12,663	138,900	478	1,822	4,637	1,822	221
Mich.	56,827,100	1,178,000	832	15,290	198,600	827	34,900	477	13,118	1,272
Minn.	72,207,800	1,409,000	1,407	11,160	115,900	965	76,264	2,178	33,280	2,048
Mo.	60,994,600	1,190,000	1,597	17,919	203,300	794	29,582	3,571	6,822	853
Nebr.	43,689,100	852,000	838	12,000	50,400	602	7,461	11,192	55,958	1,326
N. Dak.	32,041,800	647,000	330	4,196	41,100	538	48,960	0	13,796	866
Ohio	68,508,100	1,388,000	1,422	16,951	190,500	879	52,920	5,040	5,040	1,680
Okla.	38,879,700	758,000	521	9,800	111,000	710	49,370	9,896	2,447	851
S. Dak.	23,815,600	291,000	397	3,510	41,500	357	30,202	1,404	15,585	774
Tenn.	29,490,600	575,000	519	11,856	213,400	473	773	3,450	4,402	221
Wis.	59,054,600	1,224,000	1,159	10,024	115,600	1,272	30,224	3,162	9,979	1,581
DISTRICT 3										
Ala.	13,814,800	276,000	132	9,230	124,000	381	534	2,385	3,044	142
Ark.	13,842,700	277,000	182	8,735	110,700	492	339	5,590	11,011	246
La.	10,886,000	199,000	80	6,088	81,500	425	463	2,079	9,040	181
Miss.	15,836,100	318,000	131	12,067	96,700	464	857	2,356	6,237	202
N. Mex.	4,908,100	90,000	37	3,558	46,000	178	6,494	238	1,188	115
Tex.	86,631,200	1,583,000	873	25,000	224,500	1,418	119,316	14,620	11,647	1,982
DISTRICT 4										
Colo.	16,524,600	277,300	269	6,032	120,800	421	18,673	247	7,015	395
Idaho	12,512,900	210,000	200	4,597	92,000	300	7,686	0	3,617	219
Mont.	11,698,600	196,300	111	7,531	143,800	526	13,248	288	14,064	384
Utah	5,491,900	92,200	80	3,113	61,300	156	1,125	59	1,776	59
Wyo.	4,539,300	76,200	58	3,342	60,200	159	892	825	466	120
DISTRICT 5										
Ariz.	4,542,100	99,000	43	1,816	35,300	107	4,018	0	2,462	77
Calif.	87,821,500	1,505,000	714	36,375	657,500	1,450	47,561		31,707	954
Nev.	1,379,100	30,000	19	800	11,800	42	243	13	384	13
Oreg.	23,518,800	443,000	335	8,400	46,300	421	10,360	380	8,460	320
Wash.	24,734,900	441,000	419	17,360	229,400	706	10,944	676	11,162	349
TOTAL	1,406,981,300	26,811,000	24,431	467,082	5,854,200	26,177	1,069,181	112,394	406,513	29,311

†† 12 lbs. of gear grease and 4.3 lbs. of special grease per annum per auto.
† 17.2 lbs. of gear grease and 7.4 lbs. of special grease per annum per truck.
‡ 16 lbs. of grease per tractor per annum.

NOTE: Add 10% to farm tractor gasoline requirements to allow for increase in production goals.

PRODUCTION NEWS

Crude Production

March U. S. Total Up, with Gulf Coast Increase Accounting for Most of Rise. Illinois Production Off 26%; California, Kansas Show Steady Advances

NPN News Bureau

WASHINGTON—Daily production of crude petroleum during March continued on the upgrade, averaging 3,921,300 bbls. compared with 3,871,400 bbls. in February and 3,692,700 bbls. in March a year ago, Bureau of Mines reported May 26.

The average for this March was the highest since February, 1942, and the gain of about 50,000 bbls. in the national average was virtually concentrated in the Texas Gulf Coast.

Nearly all the other states and districts showed relatively little change. Illinois' production resumed the downward path, but Kansas set another new record of 316,600 b/d. California's average of 776,500 b/d, although not much above February, was the highest since October, 1929, the Bureau said.

Greatest changes which have taken place during the past year, have been in California, Illinois, Indiana, Kansas, Kentucky, Mississippi, Nebraska, Oklahoma and Texas.

Area showing greatest comparative increase is California, with a March, 1943, total production of 24,070,000 bbls., compared with 18,827,000 bbls. during March a year ago.

Illinois Off 26%

One of the largest drops over the past year has been in Illinois. During March, 1942, a total of 9,986,000 bbls. was produced compared with 7,342,000 bbls. this March—a drop of over 26%.

Texas' production has steadily increased, with the largest share of the increase taking place in the Gulf Coast district. Comparative figures are: March, 1942, 10,723,000 bbls.; this year, 13,972,000 bbls.

Table, showing production of crude by states and principal fields, for March, 1943, compared with March a year ago, follows: (figures in thousands of bbls.).

	March 1943	March 1942
Arkansas	2,214	2,302
California:		
Kettleman Hills	1,386	758
Long Beach	1,024	1,095
Wilmington	2,924	2,763
Rest of State	18,736	14,211
Total California	24,070	18,827
Colorado	170	166
Illinois	7,342	9,986
Indiana	458	604
Kansas	9,816	7,548
Kentucky	526	376
Louisiana:		
Gulf Coast	7,859	7,877
Rodessa	298	361
Rest of State	2,157	1,889
Total Louisiana	10,314	10,127
Michigan	1,795	1,527
Mississippi	1,639	2,708
Montana	639	671
Nebraska	71	122
New Mexico	2,928	2,554
New York	453	454
Ohio	293	296
Oklahoma:		
Oklahoma City	1,835	2,438
Seminole	2,445	3,035
Rest of State	6,566	6,951
Total Oklahoma	10,846	12,424
Pennsylvania	1,419	1,518
Texas:		
Gulf Coast	13,972	10,723
West Texas	6,674	7,110
East Texas	10,163	9,425
Panhandle	2,826	2,273
Rodessa	241	289
Rest of State	9,626	9,403
Total Texas	43,502	39,223
West Virginia	295	310
Wyoming:		
Lance Creek	620	694
Salt Creek	411	464
Rest of State	1,735	1,567
Total Wyoming	2,766	2,725
Other	4*	5
Total United States	**121,560**	**114,473**

*Includes Missouri (3), Tennessee (1), and Utah (—).

New Mexico Renews Membership in Oil Compact

John M. Kelley, secretary and director of the New Mexico Oil Conservation Commission, witnessed the signing May 17 by Gov. J. J. Dempsey of an extension of New Mexico's membership in the Interstate Oil Compact Commission. Gov. Dempsey is chairman of the New Mexico Oil Conservation Commission

Move by U. S. to Seize Off-Shore Lands Ires Texas Senators

NPN News Bureau

WASHINGTON—Texas Senators Connally and O'Daniel are up in arms over the suggestion that the federal government take over submerged lands off the Texas coastline as part of the Bureau of Mines' plan for oil exploration on public lands.

The question was precipitated by indications that Sen. Nye, N. Dak., would reintroduce his Joint Resolution 92 which failed of action in the last Congress. The resolution would give the government title to submerged off-shore lands.

Talking to NPN, the senators hotly maintained Texas' sovereignty over off-shore lands.

Would Fight Move

"Under no conditions would we submit to having our off-shore lands taken from us," declared Sen. Connally. He said Texas was an independent republic and owned all the land and when it came into the Union it was with the understanding that it would never have to give any of it up. "In that way," he said, "we are in a better position to resist such a move than any other state."

Sen. O'Daniel was even more emphatic in talking with NPN.

"We are not going to be victimized by bureaucratic meddling," he said.

Sen. Nye told NPN he was considering reintroducing his resolution. Indications are that the Bureau of Mines or the Interior Department is "encouraging" him.

Texas Crude Analyses Tabulated

NPN News Bureau

WASHINGTON—Bureau of Mines announces it has tabulated analyses of Texas crude oils made since 1939, when a previous report was compiled.

The new report covers samples from Texas' several new fields and some from older fields that were not covered in the earlier report. The new condensed report tabulates distillation analyses of 90 individual samples and general characteristics of gravity, color, viscosity, and sulfur content.

Los Angeles to Limit Oil Wells

NPN News Bureau

LOS ANGELES—An ordinance is being drafted by the Los Angeles City Council which will limit oil wells to one for each 40 acres inside the city. This policy has been adopted by the council to prevent crowding of new fields with deterioration of adjoining property.

At least 6 drilling projects within the city of Los Angeles are waiting approval of the Planning Commission. Action on the projects has been delayed pending an overall drilling policy for the city.

Gasoline—and Gardens, Too!

Oil Companies, Besides Supplying Fuel for Farm Tractors, Help Lick the Food Shortage With 'Backyard Agriculture'

THOUSANDS of the Victory Gardens springing up in vacant lots all over the nation today are there because of the efforts of America's oil companies. Probably no other industry as a whole has been so active in promoting Victory Gardens as a national wartime effort. Not only are oil companies encouraging their employes to plant gardens but they are providing garden plots for the public in their own communities and are working with local committees to see that the maximum acreage is planted to vegetables to beat the food shortage in 1943.

One of the most far-flung programs is that being sponsored by Shell Oil Co. Shell's president, Alexander Fraser, reports that more than 3,000,000 sq. ft. of company-owned land is being released to the public for Victory Gardens. In fact, every bit of Shell's land suitable for gardening and not being otherwise used has been offered to local civilian defense or anizations for planting.

Sponsors Garden Clubs

Shell, too, is sponsoring a chain of Shell Victory Garden Clubs, membership in which is free to company employes. It is estimated that more than 12,000 of the Shell personnel east of the Rockies will become club members.

Each club member is given a complete book on vegetable gardening. "How to do it" articles are carried periodically in the company's publications to aid the novice gardener. A booklet outlining the best methods of canning, drying and storing garden produce for winter consumption is now being prepared by Shell so that the fruits of the spring and summer endeavor will not go to waste.

In the fall the Shell Victory Garden Clubs will hold "Victory Fairs"—patterned after the old-time county fairs—and prizes and ribbons will be awarded for the best vegetables. Contests in each of the company's 18 payroll districts east of the Rockies will reward the most efficient producers per square foot of cultivated ground.

In some areas where large numbers of Shell gardeners are using company land, initial soil preparation expenses will be borne by the company and, where feasible, water will be supplied.

Shell Oil's Vice-President P. E. Lakin finds it tough going as he spades his garden plot

Sohio Grants Land

Standard Oil of Ohio also is making its land suitable for growing of vegetables available to the public. Each division manager and refinery superintendent is giving the fullest cooperation in the "food for victory" campaign.

C. William Garrison, foreman at Sohio's Latonia, Ky., refinery, is the organizer of the "Latonia Plan" which provides a quarter acre for each employe who desires to make a garden. It is estimated that the quarter-acre plots will provide families of 4 with fresh vegetables throughout the summer, with enough left over to can for winter use. Total cost to each gardener—the money to be paid to local farmers for plowing, discing and harrowing—is $3.

Editor of Standard Oil of Ohio's publication, the *Sohioan*, Miss Frances Kenney, has planned a number of helpful gardening articles to be published throughout the summer and fall months.

Posies to Potatoes

In former years Richfield Oil Corp. distributed to its West Coast customers books on the growing of wild flowers. This year, however, the company's wild flower funds have been diverted to the purchase of vegetable seeds. These seeds are made available to the public, free of charge, at Richfield service stations. Those varieties deemed easiest for the amateur gardener to grow in any type of soil under any climatic conditions are selected for distribution.

Richfield's seed program is publicized by means of service station posters, Richfield Reporter radio broadcasts 6 nights each week, etc.

For the past 16 years, Ohio Oil Co.'s president, Otto D. Donnell, and Mrs. Donnell have sponsored a lawn and garden contest in the Findlay, Ohio area. This year prizes will be awarded—not for Geraniums and Asters but for beans and tomatoes and potatoes. Several of its divisional organizations, Ohio Oil reports, are promoting their own victory gardening activities. Among these is the division at Alma, Ill., which has provided plots 50 x 150 ft. for the workers.

At some of Gulf Oil Corp.'s plants, ground has already been plowed and allotted to employes for gardens. Food used in the company's cafeterias at the plant will be supplemented this year by vegetables grown in Gulf-donated plots.

Formerly, Richfield gave away books on the growing of flowers. Now, its customers on the West Coast get vegetable seeds—gratis

"Do's and don'ts" for victory gardeners are emphasized in Mid-Continent Petroleum Corp.'s publication, *The Diamond*. Gardeners are cautioned against throwing away seed and time by failure to follow good gardening practices.

Standard Oil Co. (Ind.) employes in Huron, N. D., got off to a good start on their gardening by helping local farmers with their harvesting last fall. From office boy to assistant manager the staff donned overalls and pitched in to help harvest corn, potatoes and small vegetables and fruit.

Jersey Issues Garden Guide

The assistance of several state agricultural colleges was solicited by Standard Oil Co. (N. J.) in preparing its Victory Garden Guide. Five different editions of the Guide have been brought out for as many sections of the country. Distribution of the Guide is through service stations in New England, New York, Pennsylvania, New Jersey, District of Columbia, Maryland and Delaware. Demand for the Guide has been great—in one state alone a second print order was for 3 times the number of copies printed on the first order.

South Penn Oil Co. is cooperating with various Bradford, Pa., committees in granting garden sites to embryo gardeners. Charles F. Stevenson, vice-president of South Penn, is a member of a committee appointed by the local Rotary Club to promote the victory garden campaign.

Employes of Socony-Vacuum Oil Co., Inc., will grow better vegetables because of the company's efforts in their behalf. Some months ago the company bought 8 prints of a film on victory gardening and "Food For Victory" as produced by *Better Homes and Gardens* magazine. This film has already been shown at all of the company's eastern refineries.

Texaco Plows Land

The Texas Co. has encouraged victory gardening among employes to the extent of distributing a booklet on the subject, featuring gardening articles in company publications and by offering to plow land for its employes at certain refineries.

A victory garden kit containing beet, bean,

Sometime A. D. (After Duration) *No. 9 of a new series*

"What'll it be.. 87 or 100?"

High octane gas. Greater speed, more zip, extra mileage. That's what's in store for tomorrow's motorist. The automobile he'll be driving after the war will be a direct descendant of the mechanical giants now licking the Axis.

Need for early victory has brought rapid changes in fuels and lubricants. Finer oils and gases are serving mammoth vehicles built for speed, strength, and super-endurance. Making history now, but after the war their advantages will be used for a transportation-minded world.

New trans-country "bee-line" highways; high speed gasoline; superior lubricants; these are awaiting the dawn of peace.

Awaiting that glorious day, too, is the Petroleum Industry which will rise to new peaks of prosperity.

Anticipating the possibilities of post war markets are wise business men who are shaping their future plans accordingly. Republic, too, is making no little plans. We will pass the benefits of these developments on to the public through our dealers and jobbers. It's wise to work with Republic.

Republic's Going Places

REPUBLIC OIL CO.

BENEDUM-TREES BLDG., PITTSBURGH, PA.

Till Victory Oil is Ammunition • Use it Wisely

radish, lettuce, carrot, spinach and turnip seeds, is being distributed by Fleet-Wing Corp. The 8 packets sell for 25c. Distribution of the garden kit is being made through service stations in 6 states and is being publicized over 33 radio stations. However, it isn't always necessary for a would-be gardener to visit a Fleet-Wing service station to secure a seed kit. Radio listeners in certain areas may send their 25c to the radio station carrying the Fleet-Wing program and the garden kit will be mailed to them.

The Republic Oil Co. reports that the Benedum-Trees companies are completing a plan whereby all employes will be furnished a certain amount of fresh vegetables throughout the summer from a large central victory garden which will be financed and administered by the companies.

A number of oil companies, while they have no organized victory garden programs as yet, are encouraging their employes to take part in the campaign. These companies report that their workers, individually, are toiling after hours and on off-days, tilling the soil and planting seeds so that they won't be "caught short" next fall and winter. Included in this group are Phillips Petroleum Co., Pure Oil Co., Union Oil Co. of California and Tide Water Associated Oil Co.

Shucks, Why Use Trucks? Bucket Brigade Would Do

NPN News Bureau

WASHINGTON—It seems there were about 100 transport trucks just begging to be used to haul gasoline from the Richmond, Va., terminus of the Plantation pipeline to the "gas"-famine area of the Nation's capital, but the "government-boys" were a little slow on the uptake.

A little too slow, that is, for one oil trucker who said, in effect: "Okay, boys, if you don't want to use these trucks, I have another idea." His idea took a lot of thought, too. It took a lot of figuring and such, but he finally got it all down on paper, lined up, and totaled out, and here it is:

Take about 88,000 men and space them 6 ft. apart all the way from Richmond to Washington. Now, you have a bucket brigade, and you're all set to start moving the gasoline. It's easy. Figuring that each man could pass a 5-gal. can every 10 seconds in an 8-hour day, each shift would tote 343 bbls. a day. Multiply it by 3 and you really have something—all of 1029 bbls. a day using only 264,000 men.

Enough 'Long-Hairs' to Do Job

Now, the trucker went on, he understood that there were about that many "long-hairs" and economists, and lawyers, and such, in Washington, on the government payroll, who might conceivably be yanked off the job without the war effort bogging down too badly. On top of that—the 100 tank truck drivers could be tossed in for good measure—added to the "manpower pool", as it were—to help on the bucket brigade rather than putting so much wear and tear on the trucks on the run from Richmond to Washington.

When NPN last saw this poor fellow, he was wondering who he could discuss his "invention" with further. Has anyone any ideas?

EQUIPMENT PERSONALS

Mr. Cooling

Vice-president in charge of packers can sales now identifies **S. Carle Cooling's** office door at headquarters of the Crown Can Co. in Philadelphia.

Announcement of Mr. Cooling's promotion has been made by **Richard P. Swartz,** president of the company.

Mr. Cooling's entire business career has been in the can manufacturing business. Even before graduating from high school he spent his summer vacations working for the Seneca Can Co.—now American Can Co. After graduation he went on the full-time payroll as a time keeper. He was vice-president of the National Can Corp. when he resigned in 1941 to become general sales manager of the packers can division of Crown Can Co.

° ° °

For the 4th time, Foster Wheeler Corp., New York, has received the Navy "E" for excellence in continued production. The Army-Navy "E" pennant, with star, was presented at the Dansville, N. Y., works with **Ellsworth Easton,** president, acknowledging the award.

° ° °

Presentation of the Army-Navy "E" award to Goodyear Aircraft Corp.'s plant at Litchfield Park, Ariz., will be made May 28. The Arizona plant is engaged in building a portion of the Navy's flying patrol bombers. It is the fourth Goodyear plant to receive the joint production award.

° ° °

Three new vice-presidents have been elected by General American Transportation Corp. They are **Horace E. Coyl,** Chicago; **Donald H. Smith,** Chicago; and **William J. Stebler,** Sharon, Pa. **Cyrus L. Phillip,** vice-president, hereafter will direct the company's sales while continuing in charge of the operation of refrigerator cars. Other appointments include that of **O. J. Parks,** mechanical assistant to the first vice-president; and **Edward J. Campbell,** chief maintenance officer. **J. C. Acworth** is now an assistant vice-president.

° ° °

Stanley H. Hobson, president, received for the Geo. D. Roper Corp., Rockford, Ill., the Army-Navy "E" pennant for excellence in the production of military equipment on April 23. Presentation was made by **Col. William L. Plummer,** who in peacetime was Roper's district manager with headquarters in Atlanta, Ga.

° ° °

Ben. F. Offutt, Louisville district manager for Erie Meter Systems, has been appointed associate fuel oil rationing officer for the Eastern Kentucky district of the Office of Price Administration. His headquarters will be in Lexington, Ky. Ben's smiling face and happy disposition has been a "fixture" at Kentucky and Indiana oil conventions since shortly after the last war when he resigned his Captaincy to go into the oil equipment business.

° ° °

In Washington to serve as deputy administrator in the recently organized Food Administration is **Col. Jay L. Taylor,** for many years an executive of the Halliburton Oil Well Cementing Co. At the time of his entry into the Army in 1942 he was vice-president and general manager in charge of operations.

° ° °

A. E. Bedell has been appointed chief engineer of the Graver Tank and Manufacturing Co., Inc., in charge of all engineering and development covering all divisions of the company. His headquarters will be at East Chicago, Ind.

° ° °

A. E. Higgins, Pittsburgh, vice-president and sales manager for the Pittsburgh Equitable Meter Co.-Merco Nordstrom Valve Co., was commissioned a major in the U. S. Army Air Corps on May 8. He was immediately called for active duty.

° ° °

Executive offices of Mack Trucks, Inc. have been moved from the company's Long Island City plant to the Empire State Building, New York. The new home office will comprise 22,900 sq. feet of floor space.

° ° °

Presentation of the Army-Navy "E" award to Goodyear Aircraft Corp.'s plant at Litchfield Park, Ariz., will be made May 28. The Arizona plant is engaged in building a portion of the Navy's flying patrol bombers. It is the fourth Goodyear plant to receive the joint production award.

Pictures Auto of Future

NPN News Bureau

LOS ANGELES—Production of high octane engines no larger than a sewing machine but yielding much more power than we have today is in prospect in the postwar world, according to G. F. Olsen, manager of the research department of General Petroleum Corp. of California. Mr. Olsen told a meeting here of the American Institute of Mining and Metallurgical Engineers that the engine will be placed in the rear of the car and the driver will sit behind nothing but a transparent plastic windshield. "Construction will be much lighter and rubber-plastic tires will last as long as the car," he said.

10 Ways to Make Your ROTARY PUMPS Last Longer!

THE PUMP THAT IS SELF-ADJUSTING FOR WEAR
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TRUCK PUMPS
50 - 100 GPM.
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They are FREE to pump users.

No. 301—"FACTS about ROTARY PUMPS"
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No. 302—PUMP ENGINEERING DATA.
No. SER-1 HOW TO MAKE PUMPS LAST LONGER.

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No. 301 Facts About Rotary Pumps ☐
No. 302 Pump Engineering Data ☐

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Company .....
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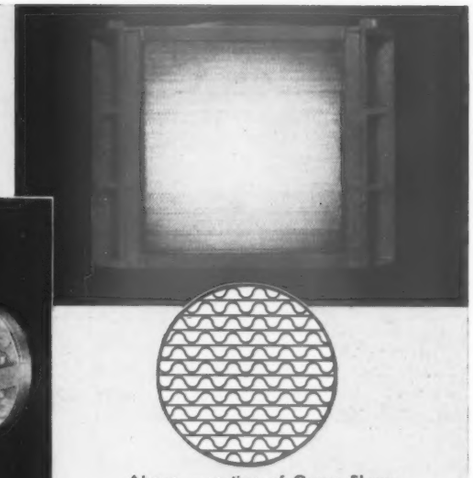
Oceco Flame Arrestor Element photographed against the light showing the absence of obstruction—and easy inspection.



Above,—section of Oceco Flame Arrestor Element — actual size — and at the left, the rigid semi-steel housing, with "element" partially removed.

OCECO *STRAIGHT THROUGH*
FLAME ARRESTOR PASSAGES

1. ***Positively prevent flame passage***
2. ***Permit free tank venting***
3. ***Minimize entrainment of condensates***
4. ***Assure easy quick inspection***

● As thousands of users know, Oceco Flame Arrestors give real protection. The corrosion-resisting "bank" or "element" assembled from flat and corrugated sheets of aluminum, arranged alternately to form vertical straight through passages is an absolute flame stop,—yet assures free tank breathing with minimum pressure drop. The entire absence of screens and tortuous channels minimizes entrainment of condensation, and clogging, avoiding "cave-ins" and "blow-outs",—and permits easy inspection simply by looking through. Rigid gas-tight semi-steel housings of Oceco Vent Units provide maximum protection against the heat of nearby fires, not afforded when housings of lower melting point material are used.

Our recently completed Catalog No. V-50 gives complete details . . . Send for a copy today!

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Engineering and Sales Representatives in the Principal Cities

FIRE PREVENTION AND VAPOR CONSERVATION EQUIPMENT
FOR VOLATILE LIQUID STORAGE TANKS

COMING MEETINGS

JUNE

The American Society of Mechanical Engineers, Hotel Biltmore, Los Angeles, Calif., Mon.-Wed., June 14-15-16.
Special Libraries Assn., second wartime conference, Hotel Pennsylvania, New York City, N. Y., Tues., Wed. and Thurs., June 22-24.
New Jersey Oil Trade Assn., annual summer golf outing, Suburban Golf Club, Elizabeth, N. J., Thurs., June 24.
American Society for Testing Materials, William Penn Hotel, Pittsburgh, Pa., Mon.-Thurs., June 28-July 1.

OCTOBER

West Virginia Petroleum Assn., Annual Convention Daniel Boone Hotel, Charlestown, W. Va., Wed., Oct. 13.
Indiana Independent Petroleum Assn., Inc., Hotel Severin, Indianapolis, Ind., Wed., Thurs., Oct. 13-14.
Mid-Continent Oil & Gas Assn., annual meeting, Blackstone Hotel, Ft. Worth Tex., Thurs.-Fri., Oct. 14-15.
Petroleum Division, National Assn. of Credit Men. St. Louis, Mo., Mon.-Wed., Oct. 25-26-27.

NOVEMBER

National Lubricating Grease Institute, annual meeting, Edgewater Beach Hotel, Chicago, Ill., Mon.-Wed., Nov. 1-2-3.
Ohio Petroleum Marketers Assn. Inc., Annual Meeting, Hotel Deshler-Wallick, Columbus, O., Wed.-Thurs., Nov. 3-4, 943.
American Petroleum Institute, 24th annual meeting, Palmer House, Chicago, Ill., Mon.-Thurs., Nov. 8-11.
The American Society of Mechanical Engineers, New York, Mon.-Fri., Nov. 29-30, Dec. 1-2-3.
South Dakota Independent Oil Men's Assn. annual meeting, Mitchell, S. D., Tues.-Wed., Nov. 30-Dec. 1.

DECEMBER

New Mexico Oil & Gas Ass'n., Artesia Hotel, Artesia, New Mexico, Wed., Dec. 1.
19th Exposition of Chemical Industries, Madison Square Garden, New York City, Mon. through Sat., Dec. 6-11.
Nebraska Petroleum Marketers, Inc., Fontenelle Hotel, Omaha, Tues.-Thurs., Dec. 7-8-9.
New Jersey Oil Trades Assn., Inc., annual banquet, Robert Treat Hotel, Newark, N. J., Thurs., Dec. 9.
Detroit Fuel Oil Distributors' Assn., annual meeting, Detroit Oil Men's Club, Leland Hotel, Detroit, Mich., Tues., Dec. 21.
San Joaquin Valley Oil Producers' Assn., Hotel El Tejon, Bakersfield, Cal., Wed., Dec. 29.

New Jersey Oil Group Plans Outing

NPN News Bureau

NEW YORK—New Jersey Oil Trade Assn. will hold its annual summer golf outing Thursday, June 24, at the Suburban Golf Club in Union, N. J. The committee in charge of arrangements for outing is composed of Frank G. Campbell, chairman; Frank J. Mahoney; and Walter W. Krautter.

Oil Librarians to Meet June 22-24

NPN News Bureau

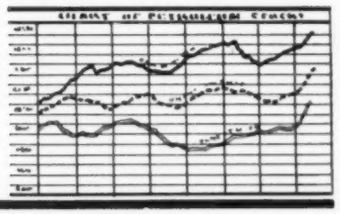
NEW YORK—Librarians of oil, oil engineering companies, and research organizations will meet at the second Wartime Conference of the Special Libraries Assn. at Hotel Pennsylvania in New York City, June 22-24. Represented in the petroleum section of the Science-Technology group are 55 companies in the petroleum industry.

Leases Go on Secured Tax Roll

NPN News Bureau

LOS ANGELES—Oil leases and mining rights are placed on secured tax rolls under a new bill passed by the California legislature. The measure is now waiting the signature of Gov. Warren.

Oil MARKETS



Mid-Continent

TULSA, May 29.—Low stocks and firm prices for most refined products were reported by mid-continent refiners, as demands of farmers for gasoline, kerosine, tractor fuel and distillates continued to increase and inventories, where any had been accumulated, to decline. Government withdrawals of solvent refined bright stocks have progressively tightened market on conventional brights until discounts from posted prices customarily allowed during the winter are no longer to be found, according to both sellers and buyers of these products. Only neutrals were said to be still plentiful, with prices still weak, as shortage of heavy stock for blending curbs consumption.

Mid-Western

CHICAGO, May 29 — Refiners and marketers in Mid-West and Central Michigan reported strengthening of gasoline demand after change in weather last week with stocks again getting dangerously low. All available gasoline and fuel oil is reported moving eastward on instructions of PAW to ship immediately and to continue shipping until further notice. Inability to get third grade gasoline in more than limited quantities has meant delaying of shipments to dealers and farmers, according to marketers and refiners. Fuel continues in strong demand, they said, because of large amount purchased by government and attempts of dealers and consumers to fill summer storages. No price changes reported.

Atlantic Coast

NEW YORK, May 29.—No signs of relief in the East Coast gasoline famine were apparent to seaboard suppliers the past week, although the prompt action of mid-western refiners in making additional transportation facilities available for the East helped a bit and was commended generally in the trade. Little hope for improvement in the situation was expressed, with recent washouts of pipeline and railroad beds caused by floods in the Mid-West. In addition, military demands had made sharp inroads in already depleted stocks, suppliers said.

Other light products also were very scarce along the seaboard, and quotations at all points were unchanged.

Pennsylvania

NEW YORK, May 29.—Higher prices for naphthas were reported in Western Penna. the week ended May 28 when one lower field refiner said he now was quoting 7.25c for untreated and 7.75c for Stoddard solvent, up 0.25c and 0.5c, respectively, over previous range highs. Range lows for both products were unchanged, however, at 7c.

No let-up in activity was reported, with demand heavy for gasoline, kerosine, fuel oils, and lubes. Steady shipments were keeping inventories drained. Brisk demand for petrolatums also was reported.

Gulf

NEW YORK, May 29.—Regular 72-74 octane gasoline in tank cars was quoted 0.25c higher in the Texas Gulf market the past week when a refiner who had been quoting this grade at 5.5c said he now was quoting 5.75c along with other refiners. One reported sale of 15 cars of 72-74 at 5.75c and approximately 70,000 bbls. in barges at the same price.

Quotations for other products were unchanged and no other open spot sales were reported, although inquiry for all products was reported.

California

LOS ANGELES, May 29.—The gasoline market remained steady and unchanged. Bottom of the range on the 3 grades of gasoline was 7c, 6c, and 5c. Refiners report that demand for Ethyl has been on the increase.

The spot fuel oil market also remained unchanged. The few spot fuel sales that were made other than by major companies were at the 95c price which has prevailed for several weeks.

CRUDE PRICES

Complete tables of crude oil prices are carried in this week's issue of NPN on pages 40 and 41.

Index of Governmental Orders Concerning Petroleum Prices

Orders, "requests", "ceilings", and other statements issued by governmental agencies concerning prices of petroleum and products, prices for which are published in this market section of NATIONAL PETROLEUM NEWS, have been published as follows:

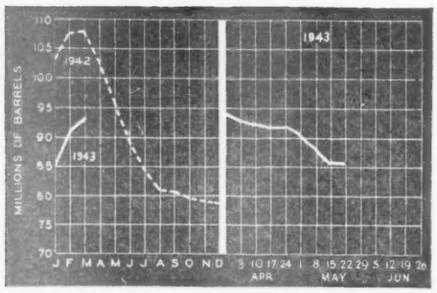
(For orders issued prior to March, see NPN of March 17, p. 47; Jan. 13, p. 41; Jan. 6, p. 41; and Nov. 25, p. 39.)

	NATIONAL PETROLEUM NEWS	PLATT'S OILGRAM	Platt's OIL-Law-GRAM
Mar. 3, '43—New ceilings for residuals and blends set up	Mar. 10, p. 10	Mar. 3, p. 2	P. 300.144
Mar. 16, '43—Fuel oil price increase of .3c extended to Washington and Oregon	Mar. 24, p. 9	Mar. 17, p. 2	P. 300.152 P. 272.54
Mar. 17, '43—Kerosine ceiling raised at Gulf Coast refineries and in District 1	Mar. 24, p. 10	Mar. 18, p. 1	P. 300.153 P. 272.55
Mar. 24, '43—Price basis for crude at well revised	Mar. 31, p. 12	Mar. 24, p. 1	P. 300.157
Mar. 26, '43—California crudes and residual ceiling increased 25c per bbl.	Mar. 31, p. 12	Mar. 26, p. 1	P. 300.159
Mar. 30 '43—Kerosine tank wagon ceiling raised .2c in Hartford, Conn. area	Apr. 7, p. 12	Mar. 30, p. 2	P. 300.167
Apr. 1, '43—California price increase extended to all levels in District 5	Apr. 7, p. 11	Apr. 1, p. 2	P. 300.164
Apr. 2, '43—.3c fuel oil increase extended to 20 Idaho counties	Apr. 7, p. 11	Apr. 3, p. 2	P. 300.169 P. 272.59
Apr. 6, '43—Only aviation gasoline with 87-octane rating or over exempt from price control	Apr. 14, p. 8	Apr. 6, p. 1	P. 272.58
Apr. 10, '43—Discount provisions revised	Apr. 14, p. 8	Apr. 12, p. 1	P. 300.170
Apr. 10, '43—Ceiling set on South Bangor Pool, Van Buren County, Mich. crude	Apr. 14, p. 8	Apr. 12, p. 1	P. 300.171
Apr. 12, '43—All California crude prices increased	Apr. 14, p. 8	Apr. 12, p. 1	P. 300.172
Apr. 22, '43—Ceiling set for Wyoming Elk Basin (Tensleep crude) of 90c per bbl.	Apr. 28, p. 14	Apr. 22, p. 1	P. 300.174
May 17, '43—Ceiling raised for North, North Central Texas and Tillman County, Okla. crude; new maximum set for Tinsley Field, Miss. crude	May 26, p. 14	May 17, p. 2	P. 300.178
May 17, '43—Ville Platte, La. crude ceiling increased	May 26, p. 14	May 17, p. 2	P. 300.180
May 18, '43—Refinery and seaboard ceiling set for No. 2 fuel oil in Boston area	May 26, p. 14	May 21, p. 2	P. 300.185
May 19, '43—Ceiling set for blenders of No. 5 fuel oil in Chicago	May 26, p. 14	May 19, p. 1	P. 300.184

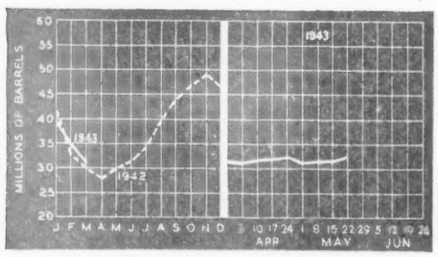
STATISTICS

Monthly figures are actual as reported by Bureau of Mines. Weekly figures are as estimated by American Petroleum Institute on Bureau of Mines basis, except crude stocks which are as reported by Bureau of Mines.

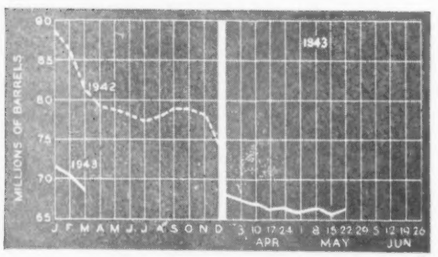
Gasoline Stocks (Finished and Unfinished)



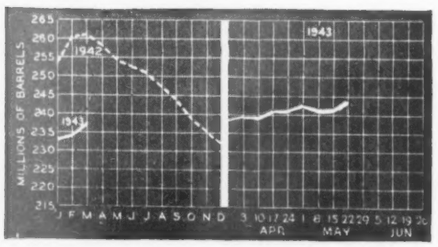
Gas Oil and Distillate Stocks



Residual Fuel Oil Stocks



Crude Stocks



Refinery Operations

(American Petroleum Institute figures in thousands of barrels of 42 gallons each. Figures include reported totals plus an estimate of unreported amounts and are therefore on a Bureau of Mines basis.)

Districts	Daily Potential Refining Capacity Week Ended May 22	Daily Potential Refining Capacity Week Ended May 15	Per Cent of Refining Capacity Reporting Week Ended May 22	Per Cent of Refining Capacity Reporting Week Ended May 15	Daily Average Crude Runs to Stills Week Ended May 22	Daily Average Crude Runs to Stills Week Ended May 15	Per Cent of Reporting Capacity Operated Week Ended May 22	Per Cent of Reporting Capacity Operated Week Ended May 15
Combined°°	2,444	2,444	88.7	88.7	1,682	1,713	68.8	70.1
Appalachian	177	177	84.8	84.8	152	156	85.9	88.1
Ind., Ill., Ky.	824	824	85.2	85.2	710	757	86.2	91.9
Okla., Kans., Mo.	416	416	80.1	80.1	341	354	82.0	85.1
Rocky Mountain	147	147	49.0	48.0	87	84	59.2	57.1
California	817	817	89.9	89.9	726	704	88.9	86.2
Total U. S.—B. of M. Basis	4,825	4,825	86.2	86.2	3,698	3,768	76.6	78.1
U. S.—B. of M. Basis, May 23, 1942					3,392			

Districts	Gasoline Production at Refineries inc. Natural Blended Week Ended May 22	Gasoline Production at Refineries inc. Natural Blended Week Ended May 15	Stocks of Finished and Unfinished Gasoline Week Ended May 22	Stocks of Finished and Unfinished Gasoline Week Ended May 15	Total Stocks Gas Oil & Distillates Week Ended May 22	Total Stocks Gas Oil & Distillates Week Ended May 15	Total Stocks Residual Fuel Oil Week Ended May 22	Total Stocks Residual Fuel Oil Week Ended May 15
Combined°°	4,550	4,688	34,260	35,498	13,545	13,257	11,175	10,794
Appalachian	378	441	2,363	2,526	790	780	480	467
Ind., Ill., Ky.	2,244	2,351	18,893	19,125	4,058	4,078	3,121	3,169
Okla., Kans., Mo.	1,061	1,059	6,512	6,641	1,748	1,677	1,505	1,498
Rocky Mt.	288	292	1,955	1,978	316	321	559	544
California	1,779	1,675	21,183	21,182	11,736	11,778	50,877	50,839
Total U. S.—B. of M. Basis	10,300	10,506	85,166°	86,950	32,193	31,891	67,717	67,311
U. S.—B. of M. Basis May 23, 1942	10,192		97,021		29,110		79,296	

°Finished 74,229,000 bbl.; Unfinished 10,937,000 bbl.
°°Includes East Coast, Inland Texas, Texas Gulf, Louisiana Gulf, and North Louisiana-Arkansas districts.

Crude Oil Stocks

(Bureau of Mines Figures in thousands of barrels)

Grade or Origin	May 15	May 22	Change from May 15
Pennsylvania Grade	2,693	2,700	+ 7
Other Appalachian	1,419	1,327	— 92
Lima-Michigan	1,011	1,033	+ 22
Illinois-Indiana	11,098	11,255	+ 157
Arkansas	2,257	2,339	+ 82
Kansas	8,362	8,617	+ 255
Louisiana:	15,044	15,387	+ 343
Northern	4,917	5,145	+ 228
Gulf Coast	10,127	10,242	+ 115
Mississippi	1,283	1,327	+ 44
New Mexico	7,042	7,179	+ 137
Oklahoma	37,731	37,440	— 291
Texas:	105,607	107,030	+1,423
East Texas	23,142	22,994	— 148
West Texas	25,184	25,484	+ 300
Gulf Texas	29,393	30,264	+ 871
Other Texas	27,888	28,288	+ 400
Panhandle	5,587	5,606	+ 19
North	7,701	7,947	+ 246
South	5,082	4,981	— 101
Other	9,518	9,754	+ 236
Rocky Mountain	13,816	13,892	+ 76
California	33,999	34,009	+ 10
Foreign	95	125	+ 30
Total gasoline-bearing in U. S.	241,457	243,660	+2,203
Heavy in California	10,261	10,091	— 170

N.P.N. Gasoline Index

	Dealer T.W. Cents Per Gal.	Tank Car Cents Per Gal.
May 17	10.57	6.75
Month ago	10.57	6.69
Year ago	10.49	6.60

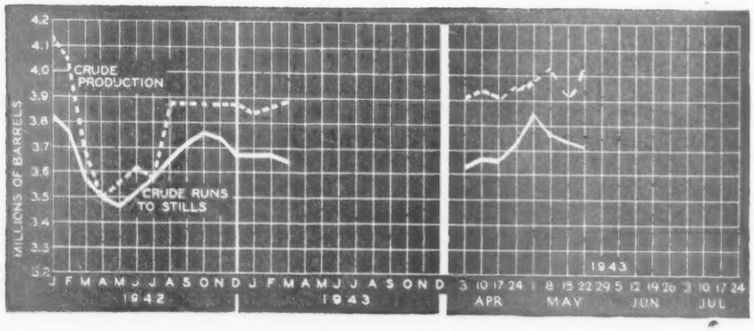
Dealer index is an average of "undivided" dealer prices, ex-tax, in 50 cities.

Tank car index is weighted average of following wholesale markets for regular-grade gasoline, FOB refineries or terminals: Okla., Mid-Western, W. Penna., Calif., N. Y. Harbor, Philadelphia, Jacksonville, Boston and Gulf Coast.

Pennsylvania Crude Runs

(Compiled by National Petroleum Assn. from reports of all companies which refined Pennsylvania crude. Figures in barrels.)

Week Ended	Daily Average	Week Ended	Daily Average
Jan. 2	75,279	Mar. 20	77,828
Jan. 9	70,842	Mar. 27	82,224
Jan. 16	78,155	Apr. 3	81,095
Jan. 23	77,551	Apr. 10	74,317
Jan. 30	74,034	Apr. 17	70,445
Feb. 6	67,494	Apr. 24	76,625
Feb. 13	69,103	May 1	76,555
Feb. 20	78,797	May 8	77,088
Feb. 27	77,285	May 15	81,628
Mar. 6	70,389	May 22	76,684
Mar. 13	73,184	1942 Low	67,243
		1942 High	87,251



U. S. Crude Oil Production

(American Petroleum Institute figures)

	WEEK ENDED May 22 Barrels (Daily Average)	WEEK ENDED May 15 Barrels (Daily Average)		WEEK ENDED May 22 Barrels (Daily Average)	WEEK ENDED May 15 Barrels (Daily Average)
Oklahoma	319,800	321,150	East'n (Ill., Ind. & Ky. excl'ed)	80,000	79,750
Kansas	311,650	305,550	Kentucky	22,600	22,200
Nebraska	2,100	2,150	Michigan	57,900	58,700
Texas	1,502,400	1,502,550	Wyoming	92,700	92,900
Louisiana	348,300	348,050	Montana	20,550	20,550
Arkansas	72,600	72,100	Colorado	6,600	6,700
Mississippi	56,350	52,450	New Mexico	96,950	96,950
Illinois	219,700	210,550	California	781,300	778,800
Indiana	14,250	13,200			
			Total U. S.	4,005,750	3,984,300

REFINERY and SEABOARD PRICES

In bulk lots by Motor Transport, Tank Car, Barge or Tanker as shown

NOTE—Parenthetical figures after prices indicate number of companies quoting when less than three companies are quoting.

HOW PRICES ARE REPORTED—

Refinery and Seaboard prices in National Petroleum News are gathered by PLATT'S OILGRAM and are published in the Monday issue of the OILGRAM.

PLATT'S OILGRAM is a reporting service issued in three identical editions daily from News Bureaus at New York, Cleveland, and Tulsa, Okla. PLATT'S OILGRAM gathers and publishes what its publisher and representatives believe to be accurate news of sales, prices and current happenings affecting the oil industry and that will be of interest to its subscribers. As this information is usually private, OILGRAM reports it according to what it is able to obtain from sources deemed reliable.

All information is supplied without guarantee as to its completeness, accuracy, time of transmission or promptness of delivery.

The subscriber receives this information for his private use and not for resale or further distribution.

Publisher reserves the right to change the extent, nature and form of showing this information at any time.

Prices shown in the tables are quotations (meaning sellers' general offers or posted prices), or actual sales prices, reported to OILGRAM by refiners for "open spot" transactions, except as otherwise specified.

Prices arrived at by discounts off a specified price or "market date of shipment," prices named in contracts or prices arrived at in accordance with any arrangement made prior to date of sale, are not for "open spot" transactions and therefore are not considered in making the price tables. Prices made to brokers and prices in "Inter-refinery" transactions are also not considered except as may be noted.

All prices are for "immediate" shipment except in Gulf Coast bulk transactions where shipment is generally to be made in ninety days. Prices are FOB refineries, pipelines, or tanker terminals in districts designated.

Prices shown are for quantities in bulk such as tank car lots, motor transport lots or barge lots; and in cents per gallon; heavy fuel oils are in dollars per barrel of 42 U.S. gallons; wax and petrolatums are in cents per pound. Prices applying to barges or cargoes only are so designated.

Prices do not include taxes or inspection fees. Prices are published at the close of the business day.

Mid-Western prices in the tables were gathered from refiners with offices located in Chicago and the surrounding territory. While the prices are quoted on a Group 3 (Oklahoma) freight basis, this is in accordance with the custom of the oil industry which uses Group 3 as a price basis for the ease of comparing prices even when the material originates in another refining district. Other refinery prices are given by and for the particular refining district where the material is made and from which it is shipped.

When prices obtained by OILGRAM do not conform to these conditions the exception and the new conditions are noted in the news lead or in conjunction with the price table by footnote or otherwise, for the particular refinery or sales district involved.

Crude oil and products covered by OILGRAM'S news and price service, except where noted, have been represented to the publisher as fully up to the customary trade specifications indicated and according to the generally accepted methods of test: and all crude oil and all products thereof as having been lawfully produced and transported.

Any apparent error should be reported to the nearest OILGRAM or National Petroleum News office at once as no correction will be made after the second issue of the OILGRAM or National Petroleum News following its publication.

NOTICE—Owing to great demand, refiners generally limit quotations to regular customers and refuse bids, though higher, from others. Refiners' prices and sales shown; bids reported in market leads.

Summary of Daily Gasoline Prices (May 24 to May 29)

	Monday May 29	Friday May 28	Thursday May 27	Wednesday May 26	Tuesday May 25
U. S. Motor (ASTM octane)					
78 octane Ethyl:					
Oklahoma	6.75 – 6.875	6.75 – 6.875	6.75 – 6.875	6.75 – 6.875	6.75 – 6.875
Mid-Western (Group 3 basis)	6.75 – 7.125	6.75 – 7.125	6.75 – 7.125	6.75 – 7.125	6.75 – 7.125
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	6.6 – 7	6.6 – 7	6.6 – 7	6.6 – 7	6.6 – 7
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	7 (2)	7(2)	7(2)	7(2)	7(2)
72-74 octane:					
Oklahoma	5.875– 6	5.875– 6	5.875– 6	5.875– 6	5.875– 6
Mid-Western (Group 3 basis)	5.875– 6	5.875– 6	5.875– 6	5.875– 6	5.875– 6
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.8 – 6	5.8 – 6	5.8 – 6	5.75 – 6	5.75 – 6
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	6	6	6	6	6
63-66 octane:					
Oklahoma	5.5 – 5.625	5.5 – 5.625	5.5 – 5.625	5.5 – 5.625	5.5 – 5.625
Mid-Western (Group 3 basis)	5.5 – 5.625	5.5 – 5.625	5.5 – 5.625	5.5 – 5.625	5.5 – 5.625
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.4 – 5.5	5.4 – 5.5	5.4 – 5.5	5.4-5.625	5.4-5.625
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.75(1)	5.75(1)	5.75(1)	5.75(1)	5.75(1)
60 octane & above:					
Oklahoma	5.125– 5.25	5.125– 5.25	5.125– 5.25	5.125– 5.25	5.125– 5.25
Mid-Western (Group 3 basis)	5.1 – 5.25	5.1 – 5.25	5.1 – 5.25	5.1 – 5.25	5.1 – 5.25
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	4.875– 5.25	4.875– 5.25	5.875– 5.25	4.875– 5.25	4.875– 5.25
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.25	5.25	5.25	5.25	5.25
Motor Gasoline, 72-74 octane (ASTM)					
New York harbor	9.2 – 9.4	9.2 –10.2	9.2 –10.2	9.2 –10.2	9.2 –10.2
New York harbor, barges	9.1 – 9.3	9.1 – 9.3	9.1 – 9.3	9.1 – 9.3	9.1 – 9.3
Philadelphia district	9.2	9.2 – 9.7	9.2 – 9.7	9.2 – 9.7	9.2 – 9.7
Baltimore district	8.95	8.95	8.95	8.95	8.95
Motor Gasoline:					
Western Penna. Bradford-Warren:					
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.5–8.95	7.5–7.75(2)	7.5–7.75(2)	7.5–7.75(2)	7.5–7.75(2)
Western Penna. Other Districts:					
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.25 – 7.3	7.25 – 7.3	7.25 – 7.3	7.25 – 7.3	7.25 – 7.3

REFINERY PRICES

Gasoline—U. S. Motor (ASTM) except where otherwise specified

Prices in Effect	May 29	May 24
OKLAHOMA		
78 oct. Ethyl	6.75 – 6.875	6.75 – 6.875
72-74 oct.	5.875– 6	5.875– 6
63-66 oct.	5.5 – 5.625	5.5 – 5.625
60 oct. & below	5.125– 5.25	5.125– 5.25
60-62, 400 e.p.	5.125 (1)	5.125 (1)
MID-WESTERN (Group 3 basis)		
78 oct. Ethyl	6.75 – 7.125	6.75 – 7.125
72-74 oct.	5.875– 6	5.875– 6
63-66 oct.	5.5 – 5.625	5.5 – 5.625
60 oct. & below	5.1 – 5.25	5.1 – 5.25
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
78 oct. Ethyl	6.6 – 7	6.6 – 7
72-74 oct.	5.8 – 6	5.8 – 6
63-66 oct.	5.4 – 5.5	5.4 – 5.5
60 oct. & below	4.875– 5.25	4.875– 5.25
60-62, 400 e.p.	5.375 (1)	5.375 (1)
W. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
78 oct. Ethyl	7 (2)	7 (2)
72-74 oct.	6	6
63-66 oct.	5.75 (1)	5.75 (1)
60 oct. & below	5.25	5.25
CENT. W. TEX. (Prices to truck transports)		
80 oct. & above	7 (2)	7 (2)
72-74 oct.	5.875–6 (2)	5.875–6 (2)
67-69 oct.	.....	.....
62 oct. & below	5.125–5.25(2)	5.125–5.25(2)
AMARILLO, TEX. (For shpt. to W. Okla. & Tex. differential territory.)		
60 oct. & below	No Price	No Price
60-62, 400 e.p.	No Price	No Price
KANSAS (For Kansas destinations only)		
78 oct. Ethyl	7.25 (1)	7.25 (1)
72-74 oct.	6 –6.2 (2)	6 –6.2 (2)
63-66 oct.	5.625–5.8 (2)	5.625–5.8 (2)
60 oct. & below	5.25 –5.4 (2)	5.25 –5.4 (2)

Prices in Effect	May 29	May 24
ARK. (For shipment to Ark. & La.)		
72-74 oct., leaded	6 (1)	6 (1)
70-72 oct. "	5.875 (1)	5.875 (1)
62 oct. "	5.5 (1)	5.5 (1)
60 oct. & below, unleaded	5.375 (1)	5.375 (1)
WESTERN PENNA. (Motor gasoline)		
Bradford-Warren:		
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.5 – 8.95	7.5 – 8.95
Other districts:		
"Q" Gasoline Min. 70 Oct. (ASTM)	7.25 – 7.3	7.25 – 7.3
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
U.S. Motor: (Oct. ASTM):		
72-74 oct.	8 – 8.5	8 – 8.5
67-69 oct.	7.5 (1)	7.5 (1)
Str. run gasoline, excluding Detroit shpt.	5.5 – 6	5.5 – 6
OHIO (S. O. Ohio quotations for statewide delivery and subject to exceptions for local price disturbances)		
72-74 oct.	8.375	8.375
CALIFORNIA U.S. Motor:		
78 oct. & above (Ethyl)	6.5 – 8.75	6.5 – 8.75
70-75 oct. (regular)	6 – 7.75	6 – 7.75
65 oct. & below (3rd grade)	5 – 6.75	5 – 6.75

Kerosine, & Gas Fuel Oils

Prices in Effect	May 29	May 24
OKLAHOMA		
41-43 grav. w.w.	4.375– 4.5	4.375– 4.5
42-44 grav. w.w.	4.5	4.5
Range Oil	4 – 4.125	4 – 4.125
No. 1 P.W.	3.875	3.875
No. 1 straw	3.875–4 (1)	3.875–4 (1)
No. 2 straw	3.625	3.625
No. 3 fuel	3.5 (2)	3.5 (2)
U. G. I. Gas Oil	3.625–3.75 (1)	3.625–3.75(1)
No. 6 fuel	.....	.....
14-16 fuel	$0.97	$0.97
MID-WESTERN (Group 3 basis)		
41-43 grav. w.w.	4.375	4.375
42-44 grav. w.w.	4.5	4.5
Range Oil	4 (2)	4 (2)
No. 1 p.w.	3.875 (1)	3.875 (1)
No. 2 straw	3.625	3.625
No. 3	3.5 (2)	3.5 (2)
No. 5	$0.85 (1)	$0.85 (1)
No. 6	$0.80 (1)	$0.80 (1)
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
41-43 grav. w.w.	4.25 – 4.75	4.25– 4.75
No. 1 P.W.	4.1 –4.2 (2)	4.1 –4.2 (2)
AMARILLO, TEX. (For shpt. to W. Okla. & Tex. differential territory.)		
41-43 grav. w.w.	No Price	No Price
No. 1 straw	No Price	No Price
KANSAS (For Kansas destinations only).		
41-43 grav. w.w.	No Price	No Price
42-44 grav. w.w.	4.7–4.875 (2)	4.7–4.875 (2)
No. 1 p.w.	4.1–4.25 (2)	4.1–4.25 (2)
No. 6 fuel	$0.85 (1)	$0.85 (1)

REFINERY PRICES (Continued)

NOTE—Parenthetical figures after prices indicate number of companies quoting when less than three companies are quoting.

NOTICE—Owing to great demand, refiners generally limit quotations to regular customers and refuse bids, though higher, from others. Refiners' prices and sales shown; bids reported in market leads.

Kerosine, & Gas Fuel Oil

(Continued)

Prices in Effect	May 29	May 24
ARK. (For shipment to Ark. and La.)		
41-43 grav. w.w.	4.625 (1)	4.625 (1)
No. 1	4 (1)	4 (1)
No. 2	3.5 (1)	3.5 (1)
No. 3 fuel	3.5 (1)	3.5 (1)
Tractor fuel, for shpt to Ark. points only	5.125 (1)	5.125 (1)
WESTERN PENNA.		
Bradford-Warren:		
45 grav. w.w.	6.55 – 8.05	6.55– 8.05
46 grav. w.w.	6.675 (1)	6.675 (1)
No. 1 fuel	6.55 – 8.05	6.55 – 8.05
No. 2 "	6.625–7.625 (2)	6.625–7.625(2)
No. 3 "	6.625–7.75 (2)	6.625–7.75 (2)
36-40 gravity	6.625–6.75 (2)	6.625–6.75(2)
Other districts:		
45 grav. w.w.	6.75 – 7.925	6.75 – 7.925
46 grav. w.w.	6.75 – 6.925	6.75 – 6.925
47 grav. w.w.	6.875– 7.05	6.875– 7.05
No. 1 fuel	6.5 – 6.675	6.5 – 6.675
No. 2 "	6.5 – 7.125	6.5 – 7.125
No. 3 "	6.5 – 7.125	6.5 – 7.125
36-40 grav., Pittsburgh dist. prices excluded	6.5 – 7	6.5 – 7
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
47-49 gravity w.w.	5.8 – 6	5.8 – 6
P.W. Distillate	5.5	5.5
No. 3 gas oil, Straw	5	5
U.G.I. gas oil	4.5 (2)	4.5 (2)
Fuel Oils (Vis. at 100).		
300-500 Vis.	....	....
100-300 Vis.	4.5	4.5
OHIO (S. O. quotations for statewide delivery)		
Kerosine	7	7
CALIFORNIA		
40-43 grav. w.w.	5 – 7	5 – 7
San Joaquin Valley:		
Heavy fuel	$1.10 (2)	$1.10 (2)
Light fuel	$1.20 (2)	$1.20 (2)
Diesel fuel	4 (2)	4 (2)
Stove dist.	3 – 5 (2)	3 – 5 (2)
Los Angeles:		
Heavy fuel	$1.10 (2)	$1.10 (2)
Light fuel	$1.20 (2)	$1.20 (2)
Diesel fuel	3.5– 4	3.5– 4
Stove dist.	3 – 5	3 – 5
San Francisco:		
Heavy fuel	$1.15 (1)	$1.15 (1)
Light fuel	$1.25 (1)	$1.25 (1)
Diesel fuel	4.5 (1)	4.5 (1)
Stove dist.	5.5 (1)	5.5 (1)

Note: All above heavy fuels meet Pacific specification 400; light fuel, spec. 300; Diesel fuels, spec. 200; and stove distillate, spec. 100.

Lubricating Oils

WESTERN PENNA.

Prices are for sales made, or offers reliably reported, to jobbers & compounders only.

Viscous Neutrals—No. 3 col. Vis. at 70°F.

200 Vis. (180 at 100°) 420-425 fl.		
0 p.t.	31.5 (1)	31.5 (1)
10 p.t.	30.5 (1)	30.5 (1)
15 p.t.	29.5 (1)	29.5 (1)
25 p.t.	23-26 (b)	23-26 (b)
150 Vis. (143 at 100°) 400-405 fl.		
0 p.t.	29.5 (1)	29.5 (1)
10 p.t.	28.5 (1)	28.5 (1)
15 p.t.	27.5 (1)	27.5 (1)
25 p.t.	21-24 (b)	21-24 (b)

(b) Offered by Mid-Western sales agent at 1c off low.

Cylinder Stocks

Brt. stk., 145-155 vis. at 210°, 540-550 fl., No. 8 col.		
10 p.t.	30.5 (1)	30.5 (1)
15 p.t.	29.5 (1)	29.5 (1)
25 p.t.	25	25
600 S.R. filterable	15	15
650 S.R.	15.5	15.5
600 fl.	16	16
630 fl.	17	17

MID-CONTINENT (F. o. b. Tulsa)

Neutral Oils (Vis. at 100° F. 0 to 10 P.P.)

Pale Oils:

Vis. Color		
60-85—No. 2	8	8
86-110—No. 2	8.5 (2)	8.5 (2)
150—No. 3	14.5	14.5
180—No. 3	15	15
200—No. 3	15	15
250—No. 3	16–16.5	16–16.5
280—No. 3	17	17
300—No. 3	18 (2)	18 (2)

Lubricating Oils (Cont'd)

Prices in Effect	May 29	May 24
Red Oils:		
180—No. 5	15 (1)	15 (1)
200—No. 5	15 (1)	15 (1)
280—No. 5	No Price	No Price
300—No. 5	17.5 (2)	17.5 (2)

Note: Viscous Neutrals, 15-25 p.p. generally are quoted 0.5c under 0-10 p.p. oils. Non-viscous oils, 15-25 p.p.; generally are quoted 0.25c under 0-10 p.p. oils.

Bright Stock—Vis. at 210°		
200 Vis. D	27 (1)	27 (1)
150-160 Vis. D:		
0 to 10 p.p.	23	23
10 to 25 p.p.	22.5–23	22.5–23
25 to 40 p.p.	23 (1)	23 (1)
150-160 Vis. E	22 (1)	22 (1)
120 Vis. D:		
0 to 10 p.p.	22 (2)	22 (2)
600 S.R. Dark Green	8.5 (1)	8.5 (1)
600 S.R. Olive Green	10–11	10–11
631 S.R.	18.5 (1)	18.5 (1)
Black Oil	5.5 (1)	5.5 (1)

QUALIFYING PRICE NOTE: Prices on neutrals are posted prices from which refiners allow special discounts, ranging to 3c to meet varying local competition.

SOUTH TEXAS Neutral Oils

Vis. Color		
Pale Oils: (*Vis. at 100°F.*)		
100 No. 1½-2½	6.5	6.5
200 No. 2-3	8.75	8.75
300 No. 2-3	9.25	9.25
500 No. 2½-3½	10	10
750 No. 3-4	10.25	10.25
1200 No. 3-4	10.375	10.375
2000 No. 4	10.5	10.5
Red Oils:		
100 No. 5-6	6.5 (2)	6.5 (2)
200 No. 5-6	8.75	8.75
300 No. 5-6	9.25	9.25
500 No. 5-6	10	10
750 No. 5-6	10.25	10.25
1200 No. 5-6	10.375	10.375
2000 No. 5-6	10.5–11.5	10.5–11.5

CHICAGO (From Mid-Continent p.l. crude.)

Neutral oils (Vis. at 100° F. 0 to 10 p.p.)

Pale Oils Vis. Color		
60-85—No. 2	9.5 (1)	9.5 (1)
86-110—No. 2	10 (1)	10 (1)
150—No. 3	15.5 (1)	15.5 (1)
180—No. 3	16 (1)	16 (1)
200—No. 3	16 (1)	16 (1)
250—No. 3	17	17
Red Oils:		
180—No. 5	16 (1)	16 (1)
200—No. 5	16 (1)	16 (1)
250—No. 5	17 (1)	17 (1)
280—No. 5	18 (1)	18 (1)
300—No. 5	18.5 (1)	18.5 (1)

Note: Viscous oils, 15 to 30 p.p. are quoted 0.5c lower; 60-85 and 86-110 No. 2 non-viscous oils, 15 to 30 p.p., 0.25c lower.

Unfiltered Steam Refined: (Viscosity at 210°)		
140	11.5 (1)	11.5 (1)
160	12.5 (1)	12.5 (1)
200	13.5 (1)	13.5 (1)
Bright stocks, 160 vis. at 210 No. 8 color:		
0 to 10 p.p.	24 (1)	24 (1)
15 to 25 p.p.	23.5 (1)	23.5 (1)
30 to 40 p.p.	21.5 (1)	21.5 (1)
E filtered Cyl. Stock	15.5 (1)	15.5 (1)

Note: To obtain prices delivered in Chicago, add 0.25c per gal.

Natural Gasoline

(Group 3 & Breckenridge prices are to blenders on freight basis shown below. Shipments may originate in any Mid-Continent manufacturing district.)

FOB GROUP 3		
Grade 26-70	3.875 (Qtns.)	3.875 (Qtns.)
FOB BRECKENRIDGE		
Grade 26-70	3.5 (Qtns.)	3.5 (Qtns.)
CALIFORNIA (FOB plants in Los Angeles basin)		
21 pound vapor pressure for blending	4.75 – 5.375	4.75 – 5.375

Naphtha and Solvent

Prices in Effect	May 29	May 24
(FOB Group 3)		
Stoddard solvent	6.625	6.625
Cleaners' naphtha	7.125	7.125
V. M. & P. naphtha	7.125	7.125
Mineral spirits	6.125	6.125
Rubber solvent	7.125	7.125
Lacquer diluent	7.375– 8.125	7.375– 8.125
Benzol Diluent	8.375– 8.625	8.375– 8.625
WESTERN PENNA.		
Bradford-Warren District:		
Stoddard Solvent	7.5 (1)	7.5 (1)
Other Districts:		
Untreated naphtha	7 – 7.25	7 – 7.25
Stoddard solvent	7 – 7.75	7 – 7.75
OHIO (S. O. quotations for statewide delivery):		
V.M.&P. naphtha, D.C. naphtha, Varnolene & Sohio solvent	10	10
Rubber solvent	9	9

Wax

White Crude Scale:

WESTERN PENNA. (Bbls. C.L.)		
122-124 A.m.p.	4.25 (2)	4.25 (2)
124-126 A.m.p.	4.25	4.25
OKLAHOMA (C.L. FOB Refinery)		
Semi-refined:		
128 AMP min., white, 50 kilo bags	No Price	No Price
132-134 AMP, bbls.	5.25 (1)	5.25 (1)

CHICAGO (FOB Chicago district refinery of one refiner, in bags, carloads. Carloads, slabs loose 0.4c less. Melting points are EMP (ASTM) methods; add 3° to convert into AMP.)

Fully refined:		
122-124 (bags only)	5.6	5.6
125-127	6	6
127-129	6.25	6.25
130-132	6.55	6.55
132-134	6.8	6.8
135-137	7.55	7.55

Petrolatums

WESTERN PENNA. (Bbls., carloads; tank cars, 0.5c per lb. less.)		
Snow White	6.125– 7.25	6.125– 7.25
Lily White	5.375– 6.125	5.375– 6.125
Cream White	4.375– 5.125	4.375– 5.125
Light Amber	3.375– 3.875	3.375– 3.875
Amber	3.125– 3.5	3.125– 3.5
Red	3 – 3.25	3 – 3.25

Group 3 Freight Rates

To Division Headquarters Points of Standard Oil Co. of Indiana

(Cents Per Gal.)

	Gasoline Kerosine	*Distillate Fuel Oil	Gas Oil and or Residual Fuel Oil
Chicago, Ill.	2.508	2.508	2.516
Decatur, Ill.	2.244	2.244	2.442
Joliet, Ill.	2.508	2.508	2.516
Peoria, Ill.	2.310	2.310	2.442
Quincy, Ill.	2.178	2.178	2.294
Indianapolis, Ind.	2.640	3.034	3.034
Evansville, Ind.	2.442	2.886	2.886
South Bend, Ind.	3.135	3.135	3.330
Detroit, Mich.	4.290	3.996	3.996
Grand Rapids, Mich.	3.828	3.828	3.922
Saginaw, Mich.	4.290	4.144	4.144
Green Bay, Wis.	2.838	2.838	3.182
Milwaukee, Wis.	2.706	2.706	2.738
La Crosse, Wis.	2.574	2.574	2.886
Minneapolis-St. Paul	2.574	2.574	2.886
Duluth, Minn.	2.838	2.838	3.256
Mankato, Minn.	2.574	2.574	2.886
Des Moines, Ia.	2.046	2.046	2.294
Davenport, Ia.	2.310	2.310	2.442
Mason City, Ia.	2.376	2.376	2.664
St. Louis, Mo.	2.046	2.046	2.072
Kansas City, Mo.	1.518	1.518	1.776
St. Joseph, Mo.	1.518	1.518	1.776
Fargo, N. D.	3.564	3.564	3.996
Huron, S. D.	3.036	3.036	3.330
Wichita			
From Ponca City	0.528	0.528	0.592
From Tulsa	0.858	0.858	0.962
From Cushing	0.792	0.792	0.888

*Not suitable for illuminating purposes.

SEABOARD PRICES EXPORT AND COASTWISE

NOTE—Parenthetical figures after prices indicate number of companies quoting when less than three companies are quoting.

NOTICE—Owing to great demand, refiners generally limit quotations to regular customers and refuse bids, though higher, from others. Refiners' prices and sales shown; bids reported in market leads.

Atlantic Coast

(Prices are of refiners, FOB their refineries & their tanker terminals, & of tanker terminal operators FOB their terminals)—Prices In Effect May 29

MOTOR GASOLINE

District:	Min. 80 Oct. '39 Research (Max. 2 cc Lead)	72-74 Oct. (ASTM)	68-70 Oct. (ASTM)
N. Y. Harb.	....	9.2 – 9.4	9.2(1)
N. Y. Harb., barges	....	9.1 – 9.3	9.1(1)
Albany	....	9.3 – 9.5	....
Philadelphia	....	9.2	....
Baltimore	....	8.95	8.85(1)
Norfolk	....	8.7 – 8.9	8.5(1)
Wilmington, N. C.	....	8.7 – 8.8	8.5(1)
Charleston	....	8.7(2)	8.1(1)
Savannah	....	8.25-8.4(2)	....
Jacksonville	....	8.275(1)	....
Miami	....	....	....
Tampa	....	8.27 – 8.4	8.275(1)
Pensacola	....	7 – 7.2(1)	6.6-6.8(1)
Mobile	....	7 – 7.2	6.6-6.8(1)
New Orleans	....	6.125 – 6.75	....
Portland	....	9.5 – 9.65	....
Boston	....	9.4 – 9.7	9.7(1)
Providence	....	9.4 – 9.7	....

FUEL OILS

	KEROSINE and/or NO. 1 FUEL	No. 2	No. 3	No. 5	No. 6
N. Y. Harb.	7.1	6.7	6.7	$1.95–$2.01 (a)	$1.65– $2.07
N. Y. Harb., barges	7	6.6	6.6	....	....
Albany	7.3	6.8	6.8(2)	$2.25(1)	$1.85–$2.27 (1)
Philadelphia	7.2	6.7	6.7	$1.98	$1.65–$2.07
Baltimore	7.2	6.7	6.7	....	$1.65–$2.07
Norfolk	7.1	6.7	6.7(1)	....	$1.65-2.07(2)
Wilmington, N. C.	7.05	6.7	....	....	....
Charleston	7.2	6.7(2)	....	....	$1.60–$2.07 (2)
Savannah	7.05(2)	....	....	....	$1.60-2.02(1)
Jacksonville	7.05(1)	6.25	....	....	$1.60-2.02(1)
Miami	7.05(1)	....	....	....	....
Tampa	7.05	6.25(2)	....	....	$1.50–$1.92 (1)
Pensacola	4.8 (1)	....	....	....	....
Mobile	4.75–5.05 (2)	....	....	....	....
New Orleans	4.25 – 4.75	3.75(2)	....	$1.27(1)	$0.85–$1.27 (2)
Portland	7.3	6.8	6.8(2)	$2.25(1)	$1.65–$2.07 (1)
Boston	7.2	6.7	6.7(2)	$1.95–$2.07 (2)	$1.65–$2.07
Providence	7.2	6.7	6.7(2)	$1.90–$1.95 (2)	$1.65–$2.07

(a) This price is for a straight-run low pour test No. 5 fuel.

	Bunker C Fuel Ships' bunkers (Ex Lighterage)	Diesel Oil Ships' bunkers (Ex Lighterage)	Diesel Oil Shore Plants	Gas House Gas Oil 28-34 Gravity
N. Y. Harbor	$1.65–$2.07	$2.78	6.7–6.8(2)	6.8(2)
Albany	$1.85(1)	$2.98(1)	6.8(1)	7(1)
Philadelphia	$1.65 –$2.07	$2.78	....	....
Baltimore	$1.65 –$2.07	$2.78	6.7(1)	6.7(1)
Norfolk	$1.65 –$2.07	$2.78	6.7(1)	6.7(1)
Charleston	$1.60 –$2.02	$2.78(2)	6.7(1)	6.7(1)
Savannah	$1.60–$2.02 (1)	$2.62(1)	....	....
Jacksonville	$1.60–$2.02 (2)	$2.62(2)	....	....
Tampa	$1.50–$1.92	$2.62(2)	....	....
New Orleans	$0.97–$1.09	$1.65(1)	4(1)	....
Portland	$1.65–$2.07 (1)	$2.86(2)	6.8(1)	6.9(1)
Boston	$1.65–$2.07	$2.78	6.7(2)	6.8(2)
Providence	$1.65–$2.07	$2.78(2)	6.7(1)	6.8(1)

Residual fuel prices generally vary with A.P.I. specifications from range low for 9.9 & below degrees to range high for 25.0 & above.

Pacific Export

(Quotations at seaboard, Los Angeles, cargo lots, except where otherwise noted.)

Prices in Effect	May 29	May 24
375 e.p. blend, 70 oct.	No Price	No Price
390 e.p. blend, 68 oct.	No Price	No Price
390 e.p. blend, 66 oct.	No Price	No Price
400 e.p. blend, 65 oct. min.	No Price	No Price
U. S. Motor, under 65 oct.	No Price	No Price
38-40 grav., w.w. kero., 150 fire point	No Price	No Price
41-43 grav., w.w. kero.	No Price	No Price
44 grav. w.w. kero	No Price	No Price
Diesel fuel, 24 & above	No Price	No Price
Diesel fuel, under 24	No Price	No Price
30-34 grav. diesel (gas oil) Pac. Spec. 200	No Price	No Price
Grade C fuel, Pac. Spec. 400	No Price	No Price

In Ship's Bunkers, or deep tank lots:

Diesel Fuel, Pac. Spec. 200	$1.40 –$1.45	$1.40 –$1.45
Grade C fuel, Pac. Spec. 400	$1.10	$1.10

Cased Goods: (Per case)

375-400 e.p. blend, 65 oct. & above	No Price	No Price
400 e.p. blend under 65 oct.	No Price	No Price
U. S. Motor	No Price	No Price
40-43 grav., w.w. kero., 150 fire point	No Price	No Price
Kero., p.w.	No Price	No Price

MID-CONTINENT LUBES

(At Gulf; in packages, FAS.; in bulk, FOB terminals)

Prices in Effect May 29

	Steel Drums	Bulk
200 Vis. D 210 brt. stock	35 (1)	28.8 (1)
150 vis. D 210 brt. stock 0-10 p.p.	31 (1)	24.8 (1)
10-25 p.p.	....	....
100 vis. D 210 brt. stock 0-10 p.p.	....	....
10-25 p.p.	....	....
200 vis. No. 3 col. neutral: 0-10 p.p.	....	....

Wax

(Melting points are AMP, 3° higher than EMP. Prices are FOB refinery and do not include bag, freight or export differentials).

Prices In Effect May 29

Crude Scale	New Orleans Export	N. Y. Domestic	N. Y. Export
124-6 Yellow	4.25 (1)	....	4.25 (1)
122-4 White	....	4.25 (2)	4.25 (2)
124-6 White	4.25 (1)	4.25	4.25
Fully Refined:			
123-5	5.2 (1)	5.2 (2)	5.2 (1)
125-7	5.2 (1)	5.2 (2)	5.2 (1)
128-30	5.6 (1)	5.6	5.6 (1)
130-32	5.85 (1)	5.85 (2)	5.85 (1)
133-5	6.15 (1)	6.15	6.15 (1)
135-7	6.4 (1)	6.4 (1)	6.4 (1)

Tanker Rates

(Approximate last paid rates, cents per bbl.; Gulf-N. Atlantic, not East of N. Y.)

Hvy. Crude & Fuel (19 to 19.9 gravity)	48
Light Crude, (30 grav. or Lighter)	43
Gasoline	40
Kerosine	40
No. 2 Fuel	42

Note: Increased wartime operating expenses in excess of above rates absorbed by War Shipping Administration.

Gulf Coast

Prices in Effect May 29

	New Orleans & Lower Mississippi to Baton Rouge Tank Cars	New Orleans & Lower Mississippi to Baton Rouge Barge	Texas Gulf Coast South of New Orleans Tank Cars	Texas Gulf Coast South of New Orleans Barges	CARGOES Domestic & Export From all Gulf Ports
MOTOR GASOLINE					
Leaded (oct. by ASTM)					
80 oct. min. Max. 3 cc lead	6.5 – 7	6.5 – 6.75	6.75 – 6.9	6.75 – 6.9	6 – 6.9
72-74 oct.	6.125	5.75-6.125	5.75	5.75	5.75
63-65 oct.	....	....	5.35	5.35	5.35
Unleaded 70 oct.	....	....	....	....	5.625– 5.75
67-68 oct.	....	....	....	....	5.5 – 5.625
65 oct.	....	5.25	....	....	5.25
60 oct.	....	....	....	....	5
KEROSINE & LIGHT FUELS					
41-43 w.w. kero.	4.125–4.75	4.125– 4.75	4.125– 4.25	4.125	4.125
42-44 w.w. kero.	....	....	4.125	4.125	4.125
No. 2 fuel oil	3.75	3.75	3.75 – 4	3.75	3.75
DIESEL & GAS OILS					
(In diesel index No.)					
Below 43 di.	....	....	....	....	3.75
43-47 di.	....	....	....	....	3.875– 4
48-52 di.	4	4	4	4	4–4.125
53-57 di.	4.125	4.125	4.125	4.125	4
58 and above	....	....	....	....	4.25

Above products in Truck Transports of 2,400 gal. and over ½c above Tank Car Prices.

NOTE—Prices for heavy fuels vary within the range given above according to gravity from 9.9 grav. and below to 25 B and above.

Naphtha

Prices in Effect May 29

	V.M.&P. Naphtha	Mineral Spirits
New York Harbor	11 (2)	10
Philadelphia district	11 (2)	10
Baltimore	10.5 (2)	9.5
Boston	11.5 (2)	10.5
Providence	11.5 (1)	10.5 (2)

HEAVY FUELS & BUNKER OILS (At all Gulf Ports)	In Cargoes	In Ship's Bunkers (Ex. lighterage)
Heavy Diesels		
Below 28 API Grav.	....	$1.35
28 API Grav. & Above	....	$1.65
Bunker C Oil	$0.85–$1.27	$0.85 –$1.27

TANK WAGON PRICES

Commercial or consumer tank car, tank wagon, dealer, and service station prices for gasoline **do not include taxes;** *they do, however, include inspection fees as shown in general footnote. Gasoline taxes, shown in separate column, include 1.5c federal, and state taxes; also city and county taxes as indicated in footnotes. Kerosine tank wagon prices also do not include taxes; kerosine taxes where levied are indicated in footnotes. Dealer discounts are shown in footnotes. These prices in effect May 29, 1943 as posted by principal marketing companies at their headquarters offices, but subject to later correction.*

S. O. New Jersey

	Esso (*Regular Grade*) Consumer Tank Wagon	Dealer T.W.	Gasoline Taxes	Kerosine T.W.
*Atlantic City, N. J.	10.2	10.7	4.5	10
*Newark, N. J.	10.2	10.7	4.5	10
Annapolis, Md.	10.55	11.05	5.5	....
Baltimore, Md.	9.95	10.45	5.5	10.8
Cumberland, Md.	11.35	11.85	5.5	12.3
Washington, D. C.	10.2	10.7	4.5	11.3
Danville, Va.	11.65	12.15	6.5	12.55
Norfolk, Va.	10.45	10.95	6.5	12.3
Petersburg, Va.	10.75	11.25	6.5	13.3
Richmond, Va.	10.75	11.25	6.5	13.3
Roanoke, Va.	11.95	12.45	6.5	12.8
Charleston, W. Va.	12.25	12.75	6.5	13.6
Parkersburg, W. Va.	11.55	12.05	6.5	13.3
Wheeling, W. Va.	11.55	12.05	6.5	13.9
Charlotte, N. C.	12.1	12.6	7.5	11.6
Hickory, N. C.	12.65	13.15	7.5	12.6
Mt. Airy, N. C.	12.5	13.0	7.5	11.8
Raleigh, N. C.	11.85	12.35	7.5	12.6
Salisbury, N. C.	12.15	12.65	7.5	13.0
Charleston, S. C.	10.95	11.45	7.5	....
Columbia, S. C.	11.8	12.3	7.5	....
Spartanburg, S. C.	12.5	13.0	7.5	....

	Mineral Spirits T.W.	V.M.&P. T.W.
Newark, N. J.	13	14.5
Baltimore, Md.	15.5	....
Washington, D. C.	15.5	....

Fuel Oils—T.W.	No. 1	No. 2	No. 3
Atlantic City, N. J.	10	9	9
Newark	10	9	9
Annapolis, Md.	....	9.25	....
Baltimore	9.8	9	9
Washington, D. C.	10.3	9.4	9.4
Norfolk, Va.	10	8.8	8.8
Petersburg	10.3	9	....
Richmond	10.3	9	9
Charlotte, N. C.	10.6	10.4	....
Hickory, N. C.	....	10	....
Raleigh	11.6	10.1	....
Charleston, S. C.	....	9	....
Columbia	....	10	....
Spartanburg	....	10.8	....

*Effective Aug. 5, '42 minimum retail resale price of 14.2c posted thru New Jersey.

Discounts:

Esso gasoline—to undivided dealers, 0.5c off dealer t.w.

Kerosine—1c off t.w. price for 25 gals. or more, under contract thru territory (Baltimore city contract not necessary) except no discount in state of New Jersey.

Naphthas—To buyers taking following quantities at one time: Newark, 2c per gal. on 200 gals. or more, less than 200 gals. 0.5c higher price; Baltimore, 2c off on 25 to 100 gals. and 3c on over 100 gals.; Washington, 2c off to contract buyers.

Socony-Vacuum Oil Co., Inc.

Socony Mobilgas (*Regular Grade*)

	Com. Cons. T.W.	Indiv. Dlr. T.W.	Gasoline Taxes
New York City			
Manhattan & Bronx	10.1	10.6	*5.5
Kings & Queens	10.1	10.6	*5.5
Richmond	9.7	10.2	*5.5
Albany, N. Y.	9.9	10.4	5.5
Binghamton, N. Y.	11	11.5	5.5
Buffalo	10.2	10.7	5.5
Jamestown, N. Y.	10.4	10.9	5.5
Mt. Vernon, N. Y.	10.1	10.6	5.5
Plattsburg, N. Y.	11	11.5	5.5
Rochester, N. Y.	10.8	11.3	5.5
Syracuse, N. Y.	10.5	11	5.5
Bridgeport, Conn.	10	10.5	4.5
Danbury, Conn.	10.5	11	4.5
Hartford, Conn.	10.6	11.1	4.5
New Haven, Conn.	10	10.5	4.5
Bangor, Me.	10.7	11.2	5.5
Portland, Me.	10.3	10.8	5.5
Boston, Mass.	9.9	10.4	4.5
Concord, N. H.	11.4	11.9	5.5
Lancaster, N. H.	12	12.5	5.5
Manchester, N. H.	11.3	11.8	5.5
Providence, R. I.	10	10.5	4.5
Burlington, Vt.	10.9	11.4	5.5
Rutland, Vt.	11	11.5	5.5

	Mineral Spirits T.W.	V.M.&P. T.W.
Buffalo, N. Y.	12.4	13.6
New York City	11	12
Rochester, N. Y.	13.2	14.4
Syracuse, N. Y.	14	....
Boston, Mass.	12	13
Bridgeport, Conn.	†16.3	†17.3
Hartford, Conn.	†16.3	†17.3
Providence, R. I.	13	14

	Kerosine Yard	Kerosine TW	Mobilfuel Diesel TC	Mobilfuel Diesel TW	Mobilheat Fuel Yard	Mobilheat Fuel TW
New York:						
Manhat'n & Bronx	7.5	10.3	....	9.3	7.1	9
Kings & Queens	7.5	10.3	....	9.3	7.1	9
Richmond	7.5	10.3	....	....	7.1	8.8
Albany	7.5	9.8	7	9.3	7	9
Binghamton	8.9	11.2	....	10.7	8.4	10.2
Buffalo	8.6	10.9	8	10.3	8.2	10
Jamestown	8.7	11	....	10.6	8.3	10
Mt. Vernon	7.6	10.3	....	9.4	7.2	9
Plattsburg	8.1	10.4	....	9.9	7.6	9.4
Rochester	8.7	11	7.9	10.2	7.9	9.7
Syracuse	8.5	10.8	7.8	10.1	7.8	9.6
Conn.:						
Bridgeport	7.8	10.3	....	....	7.2	8.8
Danbury	8.2	10.8	....	....	7.5	8.8
Hartford	8.0	10.5	....	9.5	7.2	9
New Haven	7.8	10.3	....	9.3	7	8.9
Maine:						
Bangor	7.9	10.2	7.4	9.7	7.4	9.1
Portland	7.5	10.2	7	9.3	7	9
Mass.:						
Boston	7.8	10.6	6.9	9.2	7.1	9
N. H.:						
Concord	8.4	10.7	....	....	8.2	10
Lancaster	9.5	11.8	....	....	9.2	11
Manchester	8.5	11.1	....	....	7.9	9.7
R. I.:						
Providence	7.6	9.9	6.9	9.2	7.1	8.9
Vermont:						
Burlington	8.1	10.4	7.5	9.8	7.5	9.2
Rutland	8.3	10.6	....	10	7.7	9.5

*Does not include 1% city sales tax applicable to price of gasoline (ex tax).

†In steel barrels.

Discounts: Diesel—On t.w. deliveries, 0.5c for at least 400 gals.; 1c for full tank truck.

Atlantic Refining

Atlantic White Flash Gasoline (*Regular Grade*)

	Commercial T.W.	Dealer T.W.	Gasoline Taxes	Kerosine T.W.
Philadelphia, Pa.	10.2	10.7	5.5	12.25
Pittsburgh	10.7	11.2	5.5	12.6
Allentown	10.7	11.2	5.5	12.6
Erie	10.7	11.2	5.5	12.6
Scranton	10.7	11.2	5.5	12.6
Altoona	10.7	11.2	5.5	12.6
Emporium	10.7	11.2	5.5	12.6
Indiana	10.7	11.2	5.5	12.6
Uniontown	10.7	11.2	5.5	12.6
Harrisburg	10.7	11.2	5.5	12.6
Williamsport	10.7	11.2	5.5	12.6
Dover, Del.	....	11.2	5.5	12.6
Wilmington, Del.	....	10.7	5.5	12.1
Boston, Mass.	....	10.9	4.5	....
Springfield, Mass.	....	11.8	4.5	....
Worcester, Mass.	....	11.5	4.5	....
Fall River, Mass.	....	11	4.5	....
Hartford, Conn.	....	11.6	4.5	....
New Haven, Conn.	....	11	4.5	....
Providence, R. I.	....	11	4.5	....
Atlantic City, N. J.	....	10.7	4.5	10
Camden, N. J.	....	10.7	4.5	10
Trenton, N. J.	....	10.7	4.5	10
Annapolis, Md.	....	11.05	5.5	10.8
Baltimore, Md.	....	10.45	5.5	9.8
Hagerstown, Md.	....	11.55	5.5	10.3
Richmond, Va.	....	11.25	6.5	12.3
Wilmington, N. C.	....	11.55	7.5	11.9
Brunswick, Ga.	....	10.4	7.5	‡11.1
Jacksonville, Fla.	....	10.4	8.5	12.1

	Mineral Spirits T.W.†	V.M.&P. T.W.†
Philadelphia, Pa.	11	12.5
Lancaster, Pa.	12	13.5
Pittsburgh, Pa.	12.5	13.5

Fuel Oils—T.W.	1	2	3	5	6
Phila., Pa.	10.1	9	9	5.76	5.33*
Allentown, Pa.	10.6	9.3	9.3	....	....
Wilmington, Del.	10.1	9	9	....	....
Springfield, Mass.	10.2	9.4	9.4	....	....
Worcester, Mass.	10.2	9.3	9.3	....	....
Hartford, Conn.	10.5	9	9	....	....

‡Does not include 1c Georgia kerosine tax.

†Mineral Spirits prices also apply to Stoddard Solvent; V.M.&P. prices also apply to Light Cleaners Naphtha.

Discounts:

Gasoline—to undivided dealers, 0.5c off dealer t.w., except Georgia & Florida dealer t.w. and undivided dealer t.w. prices are same.

Kerosine—Thru Penna. & Delaware, 2c off t.w. price on t.w. deliveries of 25 gals. or more at one time.

*Residual fuel 16.0-19.9 gravity.

S. O. Ohio††

***Sohio X-70 Gasoline (*Regular Grade*)**

	Consumer T.W.	**Resellers	‡S.S. Taxes	Gasoline Taxes	†Kerosine T.W.
Ohio, Statewide	12	10	13.5	5.5	9.3
Akron	12	9.5	12.5	5.5	9.3
Cincinnati	12	9.5	12.5	5.5	9.3
Cleveland	12	9.5	12.5	5.5	9.3
Columbus	12	9.5	12.5	5.5	9.3
Dayton	12	9.5	12.5	5.5	9.3
Marietta	12	9.5	12.5	5.5	9.3
Portsmouth	12	9.5	12.5	5.5	9.3
Toledo	12	9.5	12.5	5.5	9.3
Youngstown	12	9.5	12.5	5.5	9.3

Aviation Gasoline—Statewide	Consumer T.W.	Gasoline Taxes
Sohio aviation grade 65 octane, Spec. AN-VV-F-756	14.5	5.5
Esso Ethyl Aviation 73 Oct.	15.5	5.5
Esso Ethyl Aviation 80 Oct.	16.5	5.5
Esso Ethyl Aviation 87 Oct.(a)	17.5	5.5
Esso Ethyl Aviation 91 Oct.	17.5	5.5
Esso Ethyl Aviation 100 Oct.	24.5	5.5

(a) Effective Oct. 15, 1942.

	†Naphtha—T.W. Statewide	Lucas County
S. R. Solvent	13.5	13.5
D. C. Naphtha	14.5	14.25
V.M.&P. Naphtha	14.5	14.25
Varnolene	14.5	14.25
Sohio Solvent	14.5	14.25

Fuel Oils—T.W.	No. 1	No. 2	No. 3	No. 4
Ohio, Statewide	8.3	8.3	7.8	....
Cleveland	10.3	10.3	9.8	7.55

*Renown (third-grade) prices are same as X-70 unless otherwise noted.

**Except authorized agents.

†Kerosine prices are ex 1c state tax. Naphtha prices are ex 1.5c federal & 4c state tax.

‡Prices at company-operated stations.

††Statewide prices are subject to exceptions other than those shown.

Discounts:

Esso aviation—on contract to hangar operators and resellers, 2c off consumer t.w.

Fuel oils—Statewide prices are for t.w. & drum deliveries of 50 gals. or more; prices for deliveries of less than 50 gals. are 0.5c higher. Cleveland Division assumed the state-wide fuel oil tank wagon prices on Nos. 1, 2 and 3 fuel oil, effective May 10. However, the price of 7.55c per gallon on No. 4 fuel oil (full compartment hose dumps only) will remain as heretofore, in Cleveland Division.

Naphthas—to contract consumers off t.w. prices—Statewide: 300 to 999 gals., 0.5c; 1000 to 2499 gals., 0.75c; 2500 to 4999 gals., 1c; 5000 or more gals., 1.5c. Lucas County: Less than 50 gals., tank wagon price, 50 to 249 gals., 0.5c; 250 to 499 gals., 1c; 500 gals. or over, 1.5c.

S. O. Kentucky

Crown Gasoline (*Regular*) Standard (*Third Grade*)

	†Net Crown	Dealer Standard	Gasoline Taxes	Kerosine T.W.
Covington, Ky.	9.5	....	6.5	9.3
Lexington, Ky.	10.5	8.5	6.5	9.3
Louisville, Ky.	10	....	6.5	8.8
Paducah, Ky.	10	8	6.5	8.8
Jackson, Miss.	10	9	7.5	*9
Vicksburg, Miss.	9.5	....	7.5	*8.5
Birmingham, Ala.	10	9	*8.5	9
Mobile, Ala.	9	....	*9.5	8.5
Montgomery, Ala.	10	9	*9.5	10
Atlanta, Ga.	11.4	....	7.5	*12.1
Augusta, Ga.	11.4	....	7.5	*11.6
Macon, Ga.	11.4	....	7.5	12.1
Savannah, Ga.	10.4	....	7.5	11.1
Jacksonville, Fla.	10.4	....	8.5	10.1
Miami, Fla.	10.4	....	8.5	10.1
Pensacola, Fla.	9	8	*9.5	8
Tampa, Fla.	10.4	....	8.5	10.1

*Taxes: In tax column are included these city and county gasoline taxes: Mobile, 2c city; Birmingham, 1c city; Montgomery, 1c city and 1c county; Pensacola, 1c city. Georgia and Montgomery, Ala. have 1c kerosine tax, Mississippi 0.5c, not included in above prices.

†Consumer t.w. prices are same as net dealer prices.

S. O. Indiana

Red Crown (*Regular Grade*) Blue Crown (*Third Grade*)

	Red Crown Cons. T.W.	Dealer Prices Red Crown	Blue Crown	Gasoline Taxes	Kerosine T.W.
Chicago, Ill.	10.9	8.9	8.4	4.5	10.6
Decatur, Ill.	10	8.5	8	4.5	9.8
Joliet, Ill.	11.9	9.6	8.5	4.5	10.6

(Continued on next page)

Above prices include these inspection fees on both gasoline and kerosine unless otherwise specified per gallon:
Alabama 1/40c on gasoline, 1/2c on kerosine; Arkansas 1/20c; Florida 1/8c; Illinois 3/100c; Indiana 1/5c in lots of 25 bbls. or less, 2/25c in lots of more than 24 bbls.; Kansas 1/50c; Louisiana 1/32c; Minnesota 7/200c, Missouri 1/50c; Nebraska 3/100c; Nevada, gasoline 1/20c; North Carolina 1/4c; North Dakota 1/20c; Oklahoma 2/25c; South Carolina 1/8c; South Dakota 1/20c; Tennessee 2/5c; and Wisconsin 3/100c.
Kerosine inspection fees only: Iowa 3/50c; Michigan 1/5c per gal.

TANK WAGON PRICES

Commercial or consumer tank car, tank wagon, dealer, and service station prices for gasoline **do not include taxes;** *they do, however, include inspection fees as shown in general footnote. Gasoline taxes, shown in separate column, include* 1.5c *federal, and state taxes; also city and county taxes as indicated in footnotes. Kerosine tank wagon prices also do not include taxes; kerosine taxes where levied are indicated in footnotes. Dealer discounts are shown in footnotes. These prices in effect May 29, 1943 as posted by principal marketing companies at their headquarters offices, but subject to later correction.*

S. O. Indiana (Cont'd)

Red Crown (*Regular Grade*)
Blue Crown (*Third Grade*)

	Red Crown Cons. T.W.	Dealer Prices Red Crown	Blue Crown	Gasoline Taxes	Kerosine T.W.
Peoria, Ill.	11.7	9.2	9.1	4.5	10.4
Indianapolis, Ind.	11.6	9.7	9.6	5.5	*10.1
Evansville, Ind.	11.4	9.9	7.9	5.5	*9.9
South Bend, Ind.	12	10.5	10	5.5	*10.5
Detroit, Mich.	11.4	9.9	9.4	4.5	10
Grand Rapids, Mich.	10.8	9.3	8.8	4.5	9.9
Saginaw, Mich.	11.4	9.9	9.4	4.5	9.9
Green Bay, Wis.	12.2	10.7	10.2	5.5	10.9
Milwaukee, Wis.	12.1	10.6	10.1	5.5	10.8
La Crosse, Wis.	11.9	10.4	9.9	5.5	10.6
Minneapolis-St. Paul	11.9	10.4	9.5	5.5	10.6
Duluth, Minn.	12.2	10.7	10.2	5.5	10.9
Mankato, Minn.	11.9	10.4	9.5	5.5	10.6
Des Moines, Ia.	11.4	9.9	9.4	4.5	*10.1
Mason City, Ia.	11.7	10.2	9.7	4.5	*10.4
St. Louis, Mo.	10.3	8.8	8.6	*4.5	10.1
Kansas City, Mo.	10.4	8.9	7.9	*4.5	9.7
St. Joseph, Mo.	11.2	9.7	8.7	*4.5	9.7
Fargo, N. D.	12.9	11.4	10.5	5.5	11.6
Huron, S. D.	12.3	10.8	10.3	5.5	11
Wichita, Kans.	9.7	8.2	6.5	4.5	8.3

Stanavo Aviation 73 Octane

Chicago, Ill.	15.7	4.5
Milwaukee, Wis.	15.9	5.5
Minneapolis, Minn.	15.7	5.5
St. Louis, Mo.	15.2	*4.5
Kansas City, Mo.	14.8	*4.5
Fargo, N. D.	16.7	5.5
Huron, S. D.	16.1	5.5

	Oleum Spirits	V.M.&P. Naphtha	Stanisol	*Taxes
(Prices are base prices before discounts)				
Chicago	13.5	13.8	12.8	4.5
Detroit	15.8	15	16.3	4.5
K. C., Mo.	13.3	14.3	13.8	1.5
St. Louis, Mo.	13.7	14.7	13.2	1.5
Milwaukee	14.4	15.4	14.9	5.5
Minneap'lis	14.2	15.2	13.5	5.5

Fuel Oils T.W.

Chicago	Standard Heater Oil
1-99 gals.	9.3
100-149 gals.	8.3
150 gals. & over	7.8

	Stanolex Fuel Oil No. 1	Stanolex Furnace Oil
1-99 gals.	8.8	8.8
100-149 gals.	7.8	7.8
150-399 gals.	7.8	7.8
400 gals. & over	7.3	7.3

	Stanolex Fuel Oil A	Stanolex Fuel Oil B
1-99 gals.	8.3	8.3
100-399 gals.	7.3	7.3
400-749 gals.	6.3	6.3
750 gals. & over	5.55	5.55

	Stanolex Bunker C Fuel Oil
1-399 gals.	6.8
400-999 gals.	5.8
1000 gals. & over	4.8

Other Points Indianapolis	Stanolex Furnace Oil
1-99 gals.	*9.0
100 gals. & over	*8.0
Detroit	
1-99 gals.	8.7
100 gals. & over	7.7
Milwaukee	
1-99 gals.	9.0
100 gals. & over	8.0
Minneapolis	
1-99 gals.	9.1
100 gals. & over	8.1
St. Louis	
1-99 gals.	8.1
100 gals. & over	7.1
Kansas City	
1-99 gals.	8.1
100 gals. & over	7.1

*Taxes: In gasoline tax column are included these city taxes—Kansas City, St. Joseph, and St. Louis, 1c. Indiana kerosine and fuel oil prices are ex 4c state tax; Iowa kerosine prices are ex 3c state tax. In naphtha tax column are included 1.5c federal tax and state taxes.

State sales, occupation, consumer and use taxes to be added when applicable.

S. O. Nebraska

(*Regular Grade*)

	T.W. Dealer	Gasoline Taxes	Kerosine T.W.
Omaha	11.4 8.9	6.5	10.1
McCook	12.0 9.4	6.5	9.8
Norfolk	11.9 10.4	6.5	10.6
North Platte	12.3 9.9	6.5	11
Scottsbluff	12.4 9.5	6.5	9.8

S. O. Louisiana

Esso Gasoline (*Regular Grade*)

	Consumer Tank Wagon	Dealer T.W.	Gasoline Taxes	Kerosine T.W.
New Orleans, La.	8.75	9.25	8.5	*9
Baton Rouge, La.	8.75	9.25	8.5	*9.5
Alexandria, La.	8.75	9.25	8.5	*9.5
Lafayette, La.	9	9.5	8.5	*9
Lake Charles, La.	9	9.5	8.5	*11
Shreveport, La.	8.5	9	8.5	*8
Knoxville, Tenn.	9.5	10	8.5	12.5
Memphis, Tenn.	8.90	9.40	8.5	10.5
Chattanooga, Tenn.	10.5	11	8.5	11
Nashville, Tenn.	10.5	11	8.5	10
Bristol, Tenn.	10.95	11.45	8.5	13.1
Little Rock, Ark.	9.5	10	8	10

*Louisiana kerosine prices are ex 1c state tax.

Discounts:

Esso Gasoline—To undivided dealers, 0.5c off dealer t.w.

Humble Oil & Refining Co.

Humble Motor Fuel (*Regular Grade*)
Thriftane (*Third Grade*)

	Humble *Tank Wagon	Humble Re-tail	Thriftane *Tank Wagon	Thriftane Re-tail	Gasoline Taxes
Dallas, Tex.	7.5	10.5	6.5	8.5	5.5
Ft. Worth, Tex.	6.5	10.5	6	9	5.5
Houston, Tex.	8.5	12.5	7.5	10.5	5.5
San Antonio, Tex.	8.5	12.5	7.5	10.5	5.5

	Kerosine *Tank Wagon	Retail
Dallas, Tex.	7	11
Ft. Worth, Tex.	7	11
Houston, Tex.	8	11
San Antonio, Tex.		10
73 Oct. Aviation Gasoline		**Tank Car**
FOB Baytown, Tex.		8.5

*To all classes of dealers & consumers.

The Texas Co.

	Gasoline—Dealer T.W. Fire-Chief (*Regular*)	Indian (*3rd Grade*)	Gasoline Taxes
Dallas, Tex.	7.5	6.5	5.5
Ft. Worth, Tex.	6.5	6.0	5.5
Wichita Falls, Tex.	8.5	7.5	5.5
Amarillo, Tex.	8.5	7.5	5.5
Tyler, Tex.	8.5*	7.5*	5.5
El Paso, Tex.	9.5	8.5	5.5
San Angelo, Tex.	8.5	7.5	5.5
Waco, Tex.	8*	7*	5.5
Austin, Tex.	8.5	7.5	5.5
Houston, Tex.	8.5	7.5	5.5
San Antonio, Tex.	8.5	7.5	5.5
Port Arthur, Tex.	8.5	7.5	5.5

*Less 1c temporary allowance to all dealers.

Continental Oil Co.

(N.B. Prices are Continental's "structural" prices. Prices do not reflect temporary reductions made to meet local competition).

	Conoco Bronz-z-z (*Regular*) †Tank Wagon	Demand (*3rd Grade*)	Gasoline Taxes	Kerosine T.W.
Denver, Col.	11	10	5.5	11
Grand Junction, Col.	12	11	5.5	12
Pueblo, Col.	10.5	9.5	5.5	10.5
Casper, Wyo.	11.5	10.5	5.5	12
Cheyenne, Wyo.	11	10	5.5	11.5
Billings, Mont.	12.5	11.5	6.5	12.5
Butte, Mont.	13.5	12.5	6.5	13.5
Great Falls, Mont.	12.5	11.5	6.5	12.5
Helena, Mont.	13	12	6.5	13
Salt Lake City, Utah	13.5	12.5	5.5	14.5
Boise, Ida.	14.1	13.1	6.5	16.5
Twin Falls, Ida.	15.6	14.6	6.5	17
Albuquerque, N. M.	10	9	*7	9.5
Roswell, N. M.	9.5	8.5	*7	9
Santa Fe, N. M.	10.5	9.5	*7.5	10
Ft. Smith, Ark.	9.5	9.25	*7	9.5
Texarkana, Ark.	9	8	*5.5	9
Muskogee, Okla.	9.5	8.5	7	8.5
Oklahoma City, Okla.	9.5	8.5	7	8.5
Tulsa, Okla.	9.5	8.5	7	8.5

*Taxes: In gasoline tax column are included these city taxes—Albuquerque, & Roswell, 0.5c; Santa Fe, 1c. Texas 4c state tax applies within city limits of Texarkana, Ark.; Okla. 5.5c state applies within city limits of Ft. Smith, Ark.

†To consumers & dealers

S. O. California

Standard Gasoline (*Regular Grade*)
Flight Gasoline (*Third Grade*)

	Standard Posted Net Tank Truck	Standard Posted Re-tail	Flight Posted Net Tank Truck	Flight Posted Re-tail	Gasoline Taxes
San Francisco, Cal.	10	14	9	12	4.5
Los Angeles, Cal.	9.5	13.5	8.5	11.5	4.5
Fresno, Cal.	11	15	10	13	4.5
Phoenix, Ariz.	12	16	10	13	6.5
Reno, Nev.	12	16	11	14	5.5
Portland, Ore.	10.5	14.5	9.5	12.5	6.5
Seattle, Wash.	10.5	14.5	9.5	12.5	6.5
Spokane, Wash.	12.5	16.5	11.5	14.5	6.5
Tacoma, Wash.	10.5	14.5	9.5	12.5	6.5

Std. Aviation 73

	Posted Net Tank Truck	Gasoline Taxes	Kerosine Tank Truck
San Francisco, Cal.	12.5	4.5	11.5
Los Angeles, Cal.	12	4.5	10
Fresno, Cal.	13.5	4.5	12.5
Phoenix, Ariz.	14.5	6.5	12.5
Reno, Nev.	14.5	5.5	13.5
Portland, Ore.	13	6.5	13.8
Seattle, Wash.	13	6.5	13.8
Spokane, Wash.	16	6.5	16.8
Tacoma, Wash.	13	6.5	13.8

Resale & Commercial: T.C. deliveries 0.25c per gal. off posted net tank truck.

Commercial: Retail deliveries, and/or tank truck deliveries of less than 40 gals., 4c per gal. above posted net tank truck price for Standard Aviation and Standard Gasoline, and 3c per gal. above posted net tank truck for Flight Gasoline, except single deliveries of less than 40 gals. to Marine trade only, which are billed at posted net tank truck price.

Canada

PRICES ON IMPERIAL OIL, LTD.

Per Imperial Gallon, which is 1.2 U. S. Gallons

3-Star Imperial Gasoline (*Regular Grade*)

	†Gasoline T.W.	*Gasoline Taxes	†Kerosine T.W.
Hamilton, Ont.	17.5	11	18
Toronto, Ont.	17.5	11	18
Brandon, Man.	21	10	23
Winnipeg, Man.	20.5	10	22.5
Regina, Sask.	18	10	20
Saskatoon, Sask.	20.8	10	22.8
Edmonton, Alta.	18.9	10	20.9
Calgary, Alta.	16	10	18
Vancouver, B. C.	15	10	24
Montreal, Que.	17	11	17.5
St. John, N. B.	16.5	13	19
Halifax, N. S.	16.5	13	19

*Includes 3c Federal, and Provincial taxes.

†To divided & undivided dealers.

Above prices include these inspection fees on both gasoline and kerosine unless otherwise specified per gallon:

Alabama 1/40c on gasoline, 1/2c on kerosine; Arkansas 1/20c; Florida 1/8c; Illinois 3/100c; Indiana 1/5c in lots of 25 bbls. or less, 2/25c in lots of more than 25 bbls.; Kansas 1/50c; Louisiana 1/32c; Minnesota 7/200c; Missouri 1/50c; Nebraska 3/100c; Nevada, gasoline 1/20c; North Carolina 1/4c; North Dakota 1/20c; Oklahoma 2/25c; South Carolina 1/8c; South Dakota 1/20c; Tennessee 2/5c; and Wisconsin 3/100c.

Kerosine inspection fees only: Iowa 3/50c; Michigan 1/5c per gal.

CRUDE OIL PRICES

Prices in $ per bbl. of 42. U. S. gals. at the well. A. P. I. gravity. Prices are effective as of 7 a. m. of dates shown.

EASTERN & CENTRAL STATES FIELDS

PENNSYLVANIA GRADE

Posted by Jos. Seep Purch. Agency (Mar. 26, '42)

Bradford-Allegany $3.00
Southwest Penna $2.65
Eureka (West Va.) $2.59
Corning, O. (May 27, '41) $1.31

Posted by The Pennzoil Co. (Mar. 26, '41)

National Transit $2.93*

Posted by Valvoline Pipe Lines (Mar. 26, '42)

Bradford (Elk & McKean Counties, Pa.) $3.00
Warren, Forest, Venango, Clarion & Butler Counties, Pa. $2.93
Alleghany, Beaver, Washington & Greene Counties, Pa. $2.65
West Virginia $2.59
Southeastern Ohio $2.55

*Applies to Cochran, Franklin, Hamilton & Doolittle districts; prices in other lower districts range down to $2.88 per bbl. at well.

MICHIGAN

Posted by Pure Oil Co. (May 27, '41)

Midland, Midland County $1.44
Sherman $1.39

Posted by Simrall Corp.
May 27, '41

Greendale, Porter, Vernon, Crystal & Wise $1.44
Buckeye, Bentley, Edenville, Beaverton & Monitor (sweet crude type) $1.42
Freeman, Redding, Lincoln & Winterfield $1.39
West Branch-Arenac $1.24
Hamilton-Grout $1.29
Sept. 1, '42
Fork Twn.-Mecosta Co. $1.39

Posted by Sohio Corp. (Mich. Div.)

Traverse crude in Allegan, Kent, Ottawa & Van Buren Cos. (June 2, '41) $1.45
Trenton crude, Monroe Co. (June 2, '41) $1.39

Posted by Bay Pipe Line Corp. (May 27, '41)

Saginaw & Wise $1.44
Buckeye, Bentley & Kawkawlin $1.42
Clare $1.11
Adams (June 1, '41) $1.27

ILLINOIS-INDIANA-KENTUCKY-OHIO

Posted by Sohio Corp. (May 21, '41)

Illinois Basin*, including Griffin pool $1.37
Carmi, Storms, Ill. area $1.32
Birk City, Ky. area $1.32

Posted by Ohio Oil Co. (May 21, '41)

Illinois Basin $1.37
Eastern Ill. & Western Ind. $1.22

Posted by Carter Oil Co. (May 21, '41)

Loudon, Fayette Co. Ill. $1.37

Posted by Mohawk Oil Lines, Inc. (May 21, '41)

Southern Illinois $1.37

Posted by Ashland Oil & Transp. Co.

Somerset oil in Ash. Lines, Ky.: (June 19, '41)

Big Sandy River $1.38
Kentucky River $1.43

Posted by Owensboro-Ashland Co.

Owensboro, Ky. area (May 21, '41) $1.32

Posted by S. O. Ohio (Sept. 1, '41)

Lima, Ohio $1.50
Cleveland, Lodi & Chatham (O.) areas $1.30

*Also posted by The Texas Co.

MID-CONTINENT

OKLAHOMA-KANSAS-NORTH TEXAS

(See below for companies posting and dates)

Gravity	Schedule No. 1	Schedule No. 2	Schedule No. 3
Below 21	$0.85	$0.75	$0.81
21-21.9	.87	.78	.83
22-22.9	.89	.81	.85
23-23.9	.91	.84	.87
24-24.9	.93	.87	.89
25-25.9	.95	.90	.91
26-26.9	.97	.93	.93
27-27.9	.99	.96	.95
28-28.9	1.01	.99	.97
29-29.9	1.03	1.02	.99
30-30.9	1.05	1.05	1.01
31-31.9	1.07	1.07	1.03
32-32.9	1.09	1.09	1.05
33-33.9	1.11	1.11	1.07
34-34.9	1.13	1.13	1.09
35-35.9	1.15	1.15	1.11
36-36.9	1.17	1.17	1.13
37-37.9	1.19	1.19	1.15
38-38.9	1.21	1.21	1.17
39-39.9	1.23	1.23	1.19
40 & above	1.25	1.25	1.21

Above schedules posted by:

No. 1: **S. O. Indiana** May 20, '41 in Okla. & Kans. **Sinclair-Prairie** May 20, '41 in Okla & Kans. beginning with 25-25.9. **Continental** May 19, '41 in Okla. & Kans. beginning with Below 29 at $1.01. **Texaco** May 19, in Okla. & Kans. beginning with 28-28.9.

No. 2: **Carter** Nov. 1, '42 in Okla. & Kans., **Shell** Dec. 5, '41 in Okla. & Kans. **Magnolia** May 21, '41 in Okla.

No. 3: All May 22, '43: **Stanolind & Continental** in N. Tex. **Sinclair-Prairie** in N. Central Tex. **Magnolia & Texaco** in N. & N. Central Tex. **Continental, Magnolia & Sinclair-Prairie** schedules begin with Below 29 at $1.01. **Texaco** schedule begins with 28-28.9.

TEXAS & NEW MEXICO FIELDS

Posted by Humble Oil & Refining Co.
May 22, 1943

Gravity	Refugio	Texas Gulf Coast	Miran-do	Ana-huac	Dick-inson	East Central Texas	West Central Texas	Pan-handle, Texas	W. Texas & New Mex.	Hawkins Texas
Below 20	$1.08	$1.06	$1.03	$0.98	$0.93	....	....	$0.73	$0.70	$0.80
20-20.9	1.10	1.08	1.05	1.00	.95	....	....	.75	.72	.82
21-21.9	1.12	1.10	1.07	1.02	.97	....	....	.77	.74	.84
22-22.9	1.14	1.12	1.09	1.04	.99	....	....	.79	.76	.86
23-23.9	1.16	1.14	1.11	1.06	1.01	....	....	.81	.78	.88
24-24.9	1.18	1.16	1.13	1.08	1.03	....	....	.83	.80	.90
25 & above	....	....	....	....	....	....	....	....	....	.92
25-25.9	1.20	1.18	1.15	1.10	1.05	$0.97	$0.91	.85	.82	....
26-26.9	1.22	1.20	1.17	1.12	1.07	.99	.93	.87	.84	....
27-27.9	1.24	1.22	1.19	1.14	1.09	1.01	.95	.89	.86	....
28-28.9	1.26	1.24	1.21	1.16	1.11	1.03	.97	.91	.88	....
29-29.9	1.28	1.26	1.23	1.18	1.13	1.05	.99	.93	.90	....
30-30.9	1.30	1.28	1.25	1.20	1.15	1.07	1.01	.95	.92	....
31-31.9	1.32	1.30	1.27	1.22	1.17	1.09	1.03	.97	.94	....
32-32.9	1.34	1.32	1.29	1.24	1.19	1.11	1.05	.99	.96	....
33-33.9	1.36	1.34	1.31	1.26	1.21	1.13	1.07	1.01	.98	....
34-34.9	1.38	1.36	1.33	1.28	1.23	1.15	1.09	1.03	1.00	....
35-35.9	1.40	1.38	1.35	1.30	1.25	1.17	1.11	1.05	1.02	....
36-36.9	1.42	1.40	1.37	1.32	1.27	1.19	1.13	1.07	1.04	....
37-37.9	1.44	1.42	1.39	1.34	1.29	1.21	1.15	1.09	1.06	....
38-38.9	1.46	1.44	1.41	1.36	1.31	1.23	1.17	1.11	1.08	....
39-39.9	1.48	1.46	1.43	1.38	1.33	1.25	1.19	1.13	1.10	....
40 & above	1.50	1.48	1.45	1.40	1.35	1.27	1.21	1.15	1.12	....

Refugio: Includes crude purchased in Greta, Melon Creek, O'Connor-McFaddin, Plymouth, Saxet, Taft, Tom O'Connor, Refugio-Fox fields.

Texas Gulf Coast: Includes crude purchased in Amelia, Clear Lake, Goose Creek, Hastings, Magnet, Mykawa, Mykawa New, Raccoon Bend, South Thompsons, Sugarland, Thompsons, Webster, Danbury Dome and Lovell Lake fields.

Mirando: Includes crude purchased in Blanchard, Bridwell, Colorado, Comitas, Eagle Hill, Escobas, Fitzsimmons, Glen, Government Wells (North & South), Heyser, Hoffman, Kelsey, Kohler, Loma Novia, Lundell, Manilla, Mirando Valley, Placedo, Randado, Sarnosa & Tesoro, Agua Prieta and Henne-Winch-Farris fields.

Anahuac: Includes crude purchased in Anahuac, Angleton, Cedar Point, Fishers, Reef, Hull, (Old & New), Pierce Junction, Red Fish Reef, & Turtle Bay fields. Also Alief, Harris County, Texas posted by Pure Oil Co., effective Feb. 23, '43.

Dickinson: Includes crude purchased in Dickinson, Gillock, Hardin, League City, Rowan fields, Danbury Dome.

East Central Texas: Includes crude purchased in Anderson, Cherokee, Limestone, & Navarro Counties, and Navarro Crossing field.

West Central Texas: Includes crude purchased in Brown, Callahan, Comanche, Eastland, Fisher, Haskell, Jones, Shackelford, Stephens, & Throckmorton Counties.

Panhandle, Texas: Includes crude purchased in Carson, Gray Hutchinson & Wheeler Counties.

West Texas & New Mexico: Includes crude purchased in Andrews, Crane, Crockett, Ector, Gaines, Glasscock, Howard Reagan, Upton, Winkler, & Yoakum Counties, Texas; Lea County, M. N.

Hawkins: Includes crude purchased in Hawkins Field, Wood County, Texas.

Conroe $1.43
Tomball 1.40
Van 1.08
Talco 0.79
Cadena 1.35
East Texas & Flag Lake $1.25
Flour Bluff, E. Flour Bluff 1.33
Salt Flat, N. Salt Flat 1.14
Darst Creek, Hilbig, Carroll 1.14
Lintz & Tenney Creek 1.14
Bazette 1.25
Clark, Zoboroski $1.14
Alice, Benavides (N. Sweden), Sun 1.35
Ben Bolt, Clark-Muil, Tom Graham. 1.35
Yates (Pecos) 0.95
La Rosa 1.33

MAGNOLIA PETROLEUM CO.
(May 22, '43)

Panhandle, Tex.—(July 9, '41)—Same as Humble except Magnolia begins with below 29 at $0.91.
West Texas—In Crane, Upton, Howard, Glasscock, Mitchell, Winkler, Cochran, Hockley, Yoakum & Gaines Cos., and in Pecos & Andrews Cos. beginning Apr. 1, '42—Same as Humble except Magnolia begins with Below 25 at $0.80.
N. Mexico—In Lea Co.—Same as Humble except Magnolia begins with Below 25 at $0.80 & ends with 36 & above at $1.04.
Cass & Panola Cos., Tex.—Below 25 at $0.88, plus 2c per degree of gravity to 40 & above at $1.20.
Mirando, Tex.—Same as Humble.

East Texas $1.25
Darst Creek 1.14
Luling 1.05
Talco ..... .79
Lytton Springs $1.17
Cleveland-Liberty Co. 1.26
Tomball 1.40

SINCLAIR-PRAIRIE OIL MARKETING CO.

West Texas & New Mexico—(May 30, '41)—Same as Humble except Sinclair-Prairie begins with Below 25 at $0.80.
Texas Gulf Coast—(May 21, '41)—Same as Humble.
Mexia District, Texas—(May 30, '41)—Same as Humble, East Central Texas, except Sinclair-Prairie also posts Below 25 at $0.95.
East Texas—(May 21, '41) $1.25
Long Lake, Texas—(May 21, '41) $1.23
Chapel Hill (Washington Co.) Tex.:
Below 50 grav. (Jan 20, '42) $1.18
50 grav. & above (Feb 2, '42) $1.25
Mirando, Tex.—(Nov. 1, '42)—Same as Humble.
Wade City & Clara Driscoll, Tex.—(Jan. 1, '43)—Same as Humble Refugio.
Alfred & Magnolia City, Tex.—(Nov. 1, '42), $1.35

STANOLIND OIL PURCHASING CO.
(May 21, '41)

Clinton, Tex.—Same as Humble Tex. Gulf Coast except Stanolind begins with Below 21 at $1.08.
Fairbanks, N. Houston & Rosslyn, Tex.—Same as Humble Dickinson schedule.
Lake Creek, Tex.—(Apr. 9, '42)—Same as Humble Tex. Gulf Coast except Stanolind begins with Below 21 at $1.08.
E. Texas $1.25
Satsuma & Tomball, Tex. $1.40
Eureka Heights (Harris Co.)—Aug 1, '42 ..... $1.15
W. Beaumont (Mar. 1, '42)—Same as Humble Tex. Gulf Coast.
Trinity (Kittrell) **Field** (Oct. 1, '42)—Same as Humble Tex. Gulf Coast.
Dyersdale Field (Nov. 1, '42)—Same as Humble Tex. Gulf Coast.

STANOLIND OIL & GAS CO.
(May 21, '41)

Spindletop (Jefferson Co., Tex.) **& High Island** (Galveston Co., Tex.)—Same as Humble Tex. Gulf Coast.
Hendrick & Henderson (Winkler Co., Tex.)—Same as Humble West Texas except Stanolind begins with Below 26 at $0.82.
Jay Welder (Calhoun Co., Tex.)—Nov. 14, '41—Same as Humble Anahuac.
Spencer & Pyote (Ward Co., Tex.)—June 8, '42—Same as Humble W. Texas.
Magnolia Sealey South (Ward Co., Tex.)—June 8, '42—Same as Humble W. Texas except Stanolind ends with 36 & above at $1.04.

THE TEXAS CO.
(May 22, '43)

Panhandle, Tex.—Same as Humble except Texaco begins with 34-34.9 at $1.03.
W. Texas & Lea Co., N. M.—Same as Humble except Texaco posts $0.78 for 23.9 & below and ends with 36 & above at $1.04.
Texas Gulf Coast—Same as Humble except Texaco ends with 34 & above at $1.36.
Duval, Mirando, Tex.—Same as Humble Mirando except Texaco ends with 28-28.9 at $1.21.
Refugio, Tex.—Same as Humble except Texaco ends with 28-28.9 at $1.26.

East Texas $1.25
Darst Creek, Tex. $1.14
Conroe, Tex. $1.43
Hockley & Cochran Cos., Tex. .. .87

SHELL OIL CO., INC.
(May 20, '41)

West Texas & Lea Co., N. M.—Same as Humble except Shell ends with 36 & above at $1.04. Also includes Ward Co., Tex.
Fisher Co., Tex.—(Dec. 11, '41)—Same as Humble W. Central Texas except Shell begins with Below 25 at $0.89.

East Texas $1.25
Livingston field, Polk Co., Tex. $1.25
Pecos Co., Texas, (except Yates Shallow Pool) .. .95
Pecos Co., Tex., Yates Shallow Pool ..... .82
Mercy field, San Jacinto Co., Tex. (Feb. 18, '42). 1.25

CONTINENTAL OIL CO.
(May 22, '43)

Carson & Hutchinson Cos., Tex. Same as Humble Panhandle except Continental begins with Below 29 at $0.91.
Eddy Co., N. M.—Same as Humble, N. M. schedule except Continental begins with Below 29 at $0.88.

PAN AMERICAN PRODUCTION CO.
(May 21, '41)

Hastings & S. Houston, Tex.—Same as Humble Tex. Gulf Coast except Pan Am. begins with Below 21 at $1.08.
Gillock, Tex.—Same as Humble Dickinson except Pan Am. begins with Below 21 at $0.95.

East Texas $1.25
Cayuga, Tex. ..... .90
Goodrich, Tex. (Dec. 1, '41) 1.20

CRUDE OIL PRICES

Prices in $ per bbl. of 42 U. S. gals. at the well. A. P. I. gravity. Prices are effective as of 7 a. m. of dates shown.

CALIFORNIA

Posted by S. O. California, April 1, 1943

(All gravities above those quoted take highest price offered in that field)

Gravity	Signal Hill (Long Beach)	Wilmington	El Segundo	Seal Beach	Huntington Beach	Inglewood	Olinda Brea Canon	Athens-Rosecrans	Torrance	Richfield	Whittier East Coyote (La Habra)	Montebello	West Coyote Hills	Santa Fe Springs	Greeley, Canal, Wasco	Coles Levee	Mountain View	Elk Hills, Buena Vista Hills Midway-Sunset, Lakeview Area	Lost Hills	Coalinga	Gravity
14-14.9	....	$ .93	....	....	$0.96	$1.01	$0.95	....	$ .95	$0.95	$0.95	$0.97	....	....	....	....	....	$0.98	$0.98	$0.98	14-14.9
15-15.9	....	.96	....	....	1.00	1.01	.97	....	.97	.96	.97	.97	....	....	....	....	....	.98	.98	.98	15-15.9
16-16.9	....	.96	1.01	....	1.00	1.01	.97	....	.97	.96	.97	.97	....	....	....	....	....	.98	.98	.98	16-16.9
17-17.9	....	.96	1.01	....	1.00	1.01	.97	....	.97	.96	.97	.97	....	....	....	....	....	.98	.98	.98	17-17.9
18-18.9	$0.93	.96	1.01	....	1.00	1.01	.97	....	.97	.96	.97	.97	....	....	....	....	....	.98	.98	.98	18-18.9
19-19.9	.93	.96	1.01	....	1.00	1.01	.97	....	.97	.96	.97	.97	....	....	....	....	$.98	.98	.98	.98	19-19.9
20-20.9	.93	.96	1.01	....	1.00	1.01	.97	....	.97	.96	.97	.97	....	....	....	....	.98	.98	.98	.98	20-20.9
21-21.9	.93	.96	1.01	....	1.00	1.01	.97	....	.97	.96	.97	.97	....	....	....	....	.98	.98	.98	.98	21-21.9
22-22.9	.96	.98	1.02	.88	1.00	1.01	.97	....	.97	.96	.97	.97	....	....	....	....	.98	.98	.98	.98	22-22.9
23-23.9	1.00	1.02	1.05	.92	1.02	1.01	.98	....	.97	.98	1.00	.97	....	....	....	....	.98	.99	.98	.98	23-23.9
24-24.9	1.03	1.06	1.07	.97	1.05	1.04	1.01	....	1.01	1.02	1.03	.97	$0.99	....	....	....	.98	1.03	.99	.98	24-24.9
25-25.9	1.07	1.09	1.10	1.01	1.08	1.07	1.04	....	1.05	1.06	1.07	.98	1.02	....	....	....	.98	1.07	1.01	.98	25-25.9
26-26.9	1.11	1.12	1.12	1.06	1.11	1.10	1.08	....	1.09	1.10	1.11	1.01	1.06	....	....	....	.98	1.11	1.04	.98	26-26.9
27-27.9	1.15	1.15	1.15	1.10	1.14	1.14	1.11	....	1.13	....	1.15	1.05	1.10	1.04	....	....	1.01	1.15	1.07	.98	27-27.9
28-28.9	1.18	1.18	1.17	1.15	1.17	1.17	1.14	....	1.17	....	....	1.08	1.13	1.08	....	....	1.04	1.19	1.10	1.00	28-28.9
29-29.9	1.20	1.20	....	1.19	1.20	1.20	....	1.17	....	....	....	1.12	1.17	1.12	....	....	1.07	1.24	1.13	1.02	29-29.9
30-30.9	1.23	1.23	....	....	1.23	1.22	....	1.21	....	....	....	1.15	1.21	1.15	$1.01	$1.09	1.10	1.28	1.16	1.04	30-30.9
31-31.9	....	....	....	....	....	1.24	....	1.25	....	....	....	1.19	1.24	1.19	1.04	1.12	1.14	....	....	1.06	31-31.9
32-32.9	....	....	....	....	....	....	....	1.29	....	....	....	1.23	1.28	1.23	1.07	1.14	1.17	....	....	1.09	32-32.9
33-33.9	....	....	....	....	....	....	....	1.32	....	....	....	1.27	....	1.26	1.10	1.17	....	....	....	1.11	33-33.9
34-34.9	Kettleman Hills	....	....	....	....	....	....	1.36	....	....	....	1.31	....	1.30	1.13	1.20	....	....	....	1.13	34-34.9
35-35.9	....	$1.23	....	....	....	....	....	....	....	....	....	1.35	....	....	1.16	1.22	....	....	....	....	35-35.9
36-36.9	....	1.26	....	....	....	....	....	....	....	....	....	1.39	....	....	1.19	1.25	....	....	....	....	36-36.9
37-37.9	....	1.29	....	....	....	....	....	....	....	....	....	1.43	....	....	1.22	....	....	....	....	....	37-37.9
38-38.9	....	....	....	....	....	....	....	....	....	....	....	1.47	....	....	1.25	....	....	....	....	....	38-38.9
39-39.9	....	....	....	....	....	....	....	....	....	....	....	1.51	....	....	....	....	....	....	....	....	39-39.9
40-40.9	....	....	....	....	....	....	....	....	....	....	....	1.53	....	....	....	....	....	....	....	....	40-40.9

Playa Del Rey: (FOB Standard Pipe Line) 20-20.9, $0.80; 21-21.9, $0.84; 22-22.9, $0.87.
Wheeler Ridge: $0.95 for 22-22.9; 23-23.9, 24-24.9.
Newhall, Kern River, Kern Front, McKittrick & Round Mountain: 14-14.9, $0.73.

LOUISIANA-ARKANSAS

Posted by S. O. Louisiana, May 22, '41

Gravity	Atlanta, Ark et al.	De Soto, La. et al.	Rodessa, La. et al.	Olla, et al	Darrow, La. et al.	University, La.* (Baton Rouge) Shallow Production
40 & Above	$1.08	$1.18	$1.20	$1.35	$1.30	$1.48
39-39.9	1.06	1.16	1.18	1.33	1.28	1.46
38-38.9	1.04	1.14	1.16	1.31	1.26	1.44
37-37.9	1.02	1.12	1.14	1.29	1.24	1.42
36-36.9	1.00	1.10	1.12	1.27	1.22	1.40
35-35.9	.98	1.08	1.10	1.25	1.20	1.38
34-34.9	.96	1.06	1.08	1.23	1.18	1.36
33-33.9	.94	1.04	1.06	1.21	1.16	1.34
32-32.9	.92	1.02	1.04	1.19	1.14	1.32
31-31.9	.90	1.00	1.02	1.17	1.12	1.30
30-30.9	.88	.98	1.00	1.15	1.10	1.28
29-29.9	.86	.96	.98	1.13	1.08	1.26
28-28.9	.84	.94	.96	1.11	1.06	1.24
27-27.9	.82	.92	.94	1.09	1.04	1.22
26-26.9	.80	.90	.92	1.07	1.02	1.20
25-25.9	.78	.88	.90	1.05	1.00	1.18
Below 25	....	.86	.88	1.03	....	....
24-24.9	.76	....	.88	....	.98	1.16
23-23.9	.74	....	.86	....	.96	1.14
22-22.9	.72	....	.84	....	.94	1.12
21-21.9	.70	....	.82	....	.92	1.10
Below 21	.68	....	.80	....	.90	....
20-20.9	....	....	....	....	....	1.08
Below 20	....	....	....	....	....	1.06

*Posted July 2, '42.

Atlanta schedule includes Patton (a), Buckner, Lewisville, Magnolia, Village & Schuler (Jones Sand), Ark.

De Soto schedule includes Sabine, Fouke, Hommer, Miller Co., Sugar Creek, Lake St. John (4500 ft. prod.), Catahoula Lake (a) Cypress Bayou, Elm Ridge (a), Hemphill (a), Indian Bayou, Lake Larto and Nebo fields.

Rodessa schedule includes Cotton Valley & Shreveport (Cross Lake) ending with Below 25 at $0.88; Anse La Butte and Cado fields.

Olla schedule includes South Olla fields, Lake St. John (3500 ft. horizon), Little Creek (a), effective Feb. 3, 1943.

Darrow schedule includes Bayou Mallet, Bayou Sale (a), Bunkie, Choctaw, Eola, Jeanerette, Lirette, North Crowley, Pine Prairie, Port Allen, Port Barre, Potash, Roanoke, St. Martinville, South Crowley, and University (deep rod.) fields.

University schedule includes Hackberry (posted by Stanolind Oil & Gas May 21, '41 ending with 34 & above at $1.36).

Golden Meadow—Feb. 1, 1943—Same as Continental's Acadia Parish postings but in addition 31-31.9, $1.07; below 31, $1.05.

Big Creek, McKamie, Columbia (a), **Dorcheat, Macedonia** (a), **Distillates** (Sour)..$1.25
Heavy Smackover Crude..... .83
Cotton Valley Distillate (Sept. 1, '41)..... 1.40
Cotton Valley (Holloway Sand Crude)..... 1.25
Lisbon Distillate..... 1.20
Dorcheat, Macedonia Distillates (Nov. 16, '42) 1.30
(a) Initial posting which is subject to disapproval by the Office of Price Administration.

(Continued next column)

LOUISIANA-ARKANSAS *(Cont'd)*

Posted by Shell Oil Co., Inc. (May 20, '41)

	Iowa	Roanoke	Gibson
Below 20	$0.99	$0.94	$0.89
20-20.9	1.01	.96	.91
21-21.9	1.03	.98	.93
22-22.9	1.05	1.00	.95
23-23.9	1.07	1.02	.97
24-24.9	1.09	1.04	.99
25-25.9	1.11	1.06	1.01
26-26.9	1.13	1.08	1.03
27-27.9	1.15	1.10	1.05
28-28.9	1.17	1.12	1.07
29-29.9	1.19	1.14	1.09
30-30.9	1.21	1.16	1.11
31-31.9	1.23	1.18	1.13
32-32.9	1.25	1.20	1.15
33-33.9	1.27	1.22	1.17
34 & above	1.29	1.24	1.19

Iowa schedule includes Black Bayou & White Castle La. fields.

Roanoke schedule includes Chalkley, La. field.

Gibson schedule includes S. Houma, Hester & W. Lake Verret, La. fields.

Happytown field, St. Martin Par., La.....$1.15

Posted by Arkansas Fuel Oil Corp.

Urania, La. (May 22, '41).....$1.15

Olla, La Salle Parish same as Olla schedule posted by S. O. Louisiana, effective Feb. 3, 1943.

Posted by Continental Oil Co. (May 22, '43)

Tepetate, La.....$1.18
Ville Platte and Bear Field..... 1.30
Lake Arthur, La..... 1.18

Abbeville, La.

Below 36..$1.07	37-37.9..$1.11	39-39.9..$1.15
36-36.9.. 1.09	38-38.9.. 1.13	40 & above 1.17

Acadia Parish (Evangeline), La.

Below 32..$1.07	34-34.9..$1.13	37-37.9..$1.19
32-32.9.. 1.09	35-35.9.. 1.15	38-38.9.. 1.21
33-33.9.. 1.11	36-36.9.. 1.17	39-39.9.. 1.23
		40 & above 1.25

CANADIAN FIELDS

Posted by Imperial Oil Limited

Western Ontario (Nov. 6, 1939)

Petrolia.....$2.35 Oil Springs.....$2.42

Turner Valley Crude Oil (April 1, '43)

(Prices FOB producer's tankage)

33-33.9..$1.50	44-44.9..$1.72	55-55.9..$1.94	
34-34.9.. 1.52	45-45.9.. 1.74	56-56.9.. 1.96	
35-35.9.. 1.54	46-46.9.. 1.76	57-57.9.. 1.98	
36-36.9.. 1.56	47-47.9.. 1.78	58-58.9.. 2.00	
37-37.9.. 1.58	48-48.9.. 1.80	59-59.9.. 2.02	
38-38.9.. 1.60	49-49.9.. 1.82	60-60.9.. 2.04	
39-39.9.. 1.62	50-50.9.. 1.84	61-61.9.. 2.06	
40-40.9.. 1.64	51-51.9.. 1.86	62-62.9.. 2.08	
41-41.9.. 1.66	52-52.9.. 1.88	63-63.9.. 2.10	
42-42.9.. 1.68	53-53.9.. 1.90	64 & over 2.12	
43-43.9.. 1.70	54-54.9.. 1.92		

Absorption Gasoline (July 16, '41)

90% Rec., 20 lb. Reid v.p.....$2.28
90% Rec., 17 lb. Reid v.p..... 2.44

ROCKY MOUNTAIN FIELDS

Posted by Stanolind Oil & Gas Co. (May 20, '41)

Salt Creek (except Tensleep crude), **Midway & Dutton Creek, Wyo.**

Below 29..$0.96	32-32.9..$1.04	36-36.9..$1.12
29-29.9.. .98	33-33.9.. 1.06	37-37.9.. 1.14
30-30.9.. 1.00	34-34.9.. 1.08	38-38.9.. 1.16
31-31.9.. 1.02	35-35.9.. 1.10	39-39.9.. 1.18
		40 & above 1.20

Wyoming:	**Wyoming:**
Tensleep (Salt Creek) $0.82	Grass Creek Light $1.00
Tensleep (Elk Basin). .82	Grass Creek Heavy .65
Frannie Light..... .85	Elk Basin..... 1.00
Frannie Heavy..... .62	Iles, Colo..... 1.07
Hamilton Dome..... .45	

Posted by Ohio Oil Co. (May 20, '41)

Elk Basin, Wyo. Light.....$1.00
Elk Basin, Wyo., Heavy..... 0.90
Grass Creek, Wyo., Light..... 1.00
Grass Creek, Wyo., Heavy..... .65
Rock Creek, Wyo..... 1.15
Lance Creek, Wyo., (July 1, '41)..... 1.12
Oregon Basin, Wyo.*..... 0.65
Garland, Wyo.*..... 0.60
Byron, Wyo.*..... 0.70

*Postings newly added by NPN and effective March 4, 1943.

Posted by Continental Oil Co. (May 22, '43)

Ft. Collins & Wellington, Col.

Below 29..$0.96	32-32.9..$1.04	36-36.9..$1.12
29-29.9.. .98	33-33.9.. 1.06	37-37.9.. 1.14
30-30.9.. 1.00	34-34.9.. 1.08	38-38.9.. 1.16
31-31.9.. 1.02	35-35.9.. 1.10	39-39.9.. 1.18
		40 & above 1.20

Canon City & Florence, Col.....$1.05
Cat Creek, Mont.. 1.15
Big Muddy, Wyo. $1.08
Lance Creek, Wyo. 1.12

Posted by Independent Pipe Line Co. (Aug. 1, '41)

Falls City, Neb., field price.....$0.90
Falls City, Neb., loaded in tank cars..... 0.95

SOUTHEASTERN FIELDS

Posted by Allied Pipe Line Corp.

Tinsley (Miss.) Crude (May 22, '43)

24-24.9..... $ .86	32-32.9.....$1.02	
25-25.9..... .88	33-33.9..... 1.04	
26-26.9..... .90	34-34.9..... 1.06	
27-27.9..... .92	35-35.9..... 1.08	
28-28.9..... .94	36-36.9..... 1.10	
29-29.9..... .96	37-37.9..... 1.12	
30-30.9..... .98	38-38.9..... 1.14	
31-31.9..... 1.00	39-39.9..... 1.16	
	40 & Above..... 1.18	

Pickens (Miss.) Crude (Dec. 16, '41)

24-24.9.....$0.685	32-32.9.....$0.845	
25-25.9..... .705	33-33.9..... .865	
26-26.9..... .725	34-34.9..... .885	
27-27.9..... .745	35-35.9..... .905	
28-28.9..... .765	36-36.9..... .925	
29-29.9..... .785	37-37.9..... .945	
30-30.9..... .805	38-38.9..... .965	
31-31.9..... .825	39-39.9..... .985	
	40 & above..... 1.005	

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IF YOU CAN'T FIND A USE FOR IT, *Scrap it!*
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FOR SALE—Approximately 1900 cases of 5 qt. lithographed cans. One half lithographed "Sure-Penn Motor Oil" the other half "Leader Motor Oil." Make us an offer. Box No. 240.

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PROCESS ENGINEER with 21 years experience in design, construction and operation of latest developments in casinghead plants and oil refineries desires connection with refiner or manufacturer of refinery equipment. Box No. 238.

Man draft exempt, trained in sales and manufacture industrial products also able to act as lubrication engineer also experienced technical sales to compounders, national experience able to travel, desires permanent connection. Box 15, Room 1418, 59 E. Van Buren St., Chicago, Ill.

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MECHANICAL ENGINEER

Engine Research Laboratory engaged in experimental, testing and research on internal combustion engine lubricating oils and fuels and automotive problems needs graduate engineer with dynamometer and engine test experience. Give all details in reply.

Armour Research Foundation
35 W. 33rd Street, Chicago, Illinois

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Cleveland company requires experienced kettle man in the manufacture of a complete line of lubricants. This is a permanent job at a good salary. Our present employees know of this advertisement. In reply give qualifications and prompt interview will be arranged.

Box No. 232
National Petroleum News

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WANTED: Second-hand oil filling machines 1 to 10 gallons capacity. Crandall or Clevon type preferred. Address Box No. 239.

WANTED TO BUY—good horizontal or vertical bulk gasoline storage tanks located in the state of Arkansas, southeastern Oklahoma, northeastern Texas or northwestern Louisiana. Contact Central States Oil Company, P. O. Box 153, Clayton, Missouri; describing same and their locality.

WANTS: STEEL STORAGE TANKS, from 2500 to 50,000 gal. Advise location, dimensions, thickness of plate in first letter for immediate inspection.

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National Petroleum News

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National Petroleum News

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About OIL PEOPLE

Doctor Egloff

The 1943 recipient of the Columbia University Medal of Merit, awarded annually to an outstanding scientific and technological leader in industry, is **Dr. Gustav Egloff**, Chicago, director of research, Universal Oil Products Co. The medal was presented June 1.

Dr. Egloff has been prominent for more than 25 years in research and invention in the development of processes for petroleum refining. He received the degree of Doctor of Philosophy from Columbia in 1916; was graduated from Cornell with an A.B. in 1912.

In recognition of his work Dr. Egloff has been elected to represent American science and technology at 12 international meetings. He is the author of more than 500 articles relating the petroleum industry and the chemistry of hydrocarbons and about 300 patents have been issued to him in the U. S. and abroad.

° ° °

Lt. Col. Robert M. Bacher, formerly with the engineering department of the Humble Oil and Refining Co., has been appointed commanding officer of the Pantex Ordnance Works at Amarillo, Tex.

° ° °

John Arnes, Cleveland, of Ohio Standard's economics department, has accepted appointment as secretary of the statistics and economics subcommittee of the District 2 general committee. He is due to arrive in Chicago soon to take up his new duties at industry headquarters, 624 S. Michigan Ave.

° ° °

Ed Gideon, formerly with Humble Oil and Refining Co.'s sales accounting force in Houston, has won his first lieutenant's bars and is now supply officer for the Del Valle Army Air Base, Austin, Tex.

° ° °

Kenneth T. White has been transferred to Warren Petroleum Corp.'s new office in Houston, Tex., as special representative to handle liquefied petroleum gas and natural gas and to work with **Walter Kiley,** general superintendent of terminals.

° ° °

R. P. Baker, Chicago, Pure Oil Co., has taken a leave from his work in order to have an operation which has been trying to catch up with him for some time. He is now at Grant Hospital, Chicago, and intends to spend some time at home convalescing after the operation.

The honorary degree of Doctor of Laws was conferred upon **Dr. R. E. Wilson,** president of Pan American Petroleum & Transport Co., by Colby College at Waterville, Me., on May 24. Dr. Wilson delivered the commencement address, speaking on "Individuals and Incentives". He stressed the necessity of maintaining properly balanced incentives for labor, management and capital if our past rate of progress under the "hope of profit" system is to be continued.

° ° °

C. B. Jewell, Springfield, secretary of the Illinois Petroleum Industries Committee, is convalescing at his home from a heart attack, after spending several weeks in the hospital. Mr. Jewell was retail merchandising manager for Shell Oil Co. until he left the organization 3 years ago.

° ° °

Frank H. Kenan of Kenan Oil Co., Durham, N. C., has been promoted to a lieutenant (j.g.) in the navy. He is stationed at Charleston, S. C.

° ° °

J. Norvelle Walker, general auditor of the Royal Oil & Gas Corp., Philadelphia, has been elected treasurer of the Philadelphia Control of The Controllers Institute of America.

° ° °

Xerna R. Campbell, Springfield, Mo., is now director of ODT's Division of Railway Transport in charge of oil movement in St. Louis, Mo., succeeding **Clyde W. Pace,** who has resigned. With the exception of one year during the last war when he served with the Corps of Army Engineers, Mr. Campbell, a native of Skidmore, Mo., has spent his entire railroad career with the St. Louis-San Francisco Railway. Until he came with the ODT, he had been serving as Train Rules Examiner, but his duties required him to watch traffic congestion and supervise troop movements over the entire Frisco system.

° ° °

New Cleveland division manager of Shell's jobber and fuel oil department is **P. E. Hartley,** replacing **John E. Schwade** who resigned May 1 to join the Allied Oil Co., Cleveland. Mr. Hartley was formerly commercial accounts representative for Shell in Cleveland.

° ° °

Walter M. Miller, Ponca City, vice-president in charge of manufacturing for Continental Oil Co., was awarded an honorary degree of doctor of engineering by the University of Tulsa at its graduation ceremony May 3. The award was granted in recognition of more than 30 years' service in the petroleum industry, particularly in the development of modern lubricating oils and in pioneering the use of synthetic additives.

E. O. Bennett, Ponca City, Okla., chief petroleum engineer for Continental Oil Co., has been awarded the honorary degree of doctor of engineering at the graduation exercises of Texas A. and M. College. The award was in recognition of his outstanding contributions to engineering science. He holds the 1942 Hanlon award for distinguished service to the natural gasoline industry.

° ° °

H. E. Sibley, Chicago, editor of Pure Oil Co.'s house organ, *Pure Oil News*, is temporarily on the sick list. Nothing serious, according to his fellow worker, **Irwin Lamp.** Mr. Lamp came to Chicago from his Washington assignment with Pure about 2 weeks ago to handle publicity, formerly taken care of by **Douglas Campbell,** who is now in the Army.

° ° °

Mrs. M. O. Bunge (Maxine Stone to hundreds of oil men) has resigned as secretary of the National Dixie Distributors, Inc., to be with her husband in Portland, Ore. Because of her resignation, the office of National Dixie will be moved from Hillsdale, Mich., to 206 Fritz Bldg., Ann Arbor, Mich., under the supervision of **Paul Kempf,** Staebler-Kempf Oil Co., who is chairman of the Dixie executive committee.

° ° °

Ensign Weston

Navy and Marine Corps Medal for outstanding service while on duty was awarded recently by President Roosevelt to Ensign Louis J. Weston, USNR, formerly a salesman with Shell Oil Co.'s Hartford division.

Ensign Weston, who entered the service as an enlisted man and worked up to his present grade, was the hero of a recent West Coast plane crash. The event was described in his citation as follows:

"While commanding a jeep lighter in San Diego Bay, Ensign Weston, seeing a plane crash about 150 yards off shore, rushed to the accident at full speed, and as he neared the wreck, pulled off his clothes and dove into the Bay. By treading water, he was able to free one of the airmen, but the other victim was trapped in the wreckage with his head below water. Breaking the cowling with a wrench, Ensign Weston reached through the broken glass and for nearly 40 minutes held the man's head above the icy water while others struggled to free his legs. Ensign Weston's quick thinking and gallant efforts in saving the lives of two airmen at the risk of his own were in keeping with the highest traditions of the United States Naval Service."

About 40 friends of **Hamilton E. Wright** turned out May 19 for a farewell dinner at the National Press Club, marking his leaving WPB where he was director of the industrial salvage branch. There were music and libations aplenty. "Ham" was presented with a useful household utensil which should serve him in good stead if he ever lives in a house without plumbing conveniences. Among those present were **Merrill Stubbs,** Mr. Wright's successor as director of the industrial salvage branch, **E. W. Grebb,** deputy director under Mr. Wright, **R. T. Lawrence,** chief of the petroleum unit in the salvage branch, and **G. Denny Moore,** manager of Gasoline Pump Manufacturers Assn.

° ° °

Charles Boyd, Jr., with NPN for 7 years in the main editorial office at Cleveland and for the past 2 years one of the helmsmen on the news desk, is now Apprentice Seaman Boyd at the Great Lakes Naval Training Station, Great Lakes, Ill.

° ° °

Dr. Surface

Dr. F. M. Surface, manager of the sales research department of the Standard Oil Co. of New Jersey, has been named to coordinate all sales research work for the foreign and domestic companies of the Standard Oil Co. (N. J.).

Dr. Surface joined Jersey Standard in 1933 after having served the U. S. government for several years in the fields of biology and economics. He was assistant chief of the statistical division of the U. S. Food Administration from 1917 until 1918 and was food statistician for the American Commission to Negotiate Peace, at Paris, in 1919. For 6 years before joining Standard of New Jersey Dr. Surface was assistant director of the Bureau of Foreign and Domestic Commerce, in charge of domestic commerce for the United States Department of Commerce in Washington.

F. R. Ficken

F. R. Ficken has been named manager of the sales research department of Standard Oil of New Jersey, succeeding Dr. Surface. Mr. Ficken started with Jersey Standard in 1926 as an office boy in the treasurer's department, subsequently held various positions in the sales department, and in 1933 was named head of the statistical division of the sales research department.

° ° °

E. C. (Gene) Moriarity, active for 20 years in the Derby Oil Co. and lately associated with A. L. Derby and A. S. Ritchie in the D.R.M. Co., was recently elected mayor of Wichita, Kan., after re-election to the city commission.

R. C. Osterstrom

R. C. Osterstrom, Toledo, Ohio, manager of Pure Oil Co.'s refinery there, has resigned to become vice-president of the Velsicol Corp., Chicago. Mr. Osterstrom, with Pure for the past 20 years, started his business career with Gulf Oil Corp. at Bayonne, N. J., later moving to Port Arthur, Tex. He served with the Navy on foreign duty during the first World War, then became affiliated with Sinclair Refining at East Chicago as assistant to the chief chemist. He joined Pure as chief chemist, subsequently becoming executive assistant to the vice-president in charge of manufacturing. The Velsicol Corp. produces petroleum chemicals and derivatives.

° ° °

N. B. (Newt) York has been named process superintendent of the Mid-Continent Petroleum Corp.'s lubricating oil department at the company's West Tulsa refinery, dividing responsibilities with **Finley O'Brien,** process superintendent of light oils.

° ° °

E. R. Page took up duty as the operations manager of the St. Louis Division of Shell April 1. A graduate of Washington University, Mr. Page started with the company as a laborer in 1933 and worked up to become chief engineer of the company's products pipeline department within 8 years.

° ° °

Edward M. Dons, formerly chief plant engineer, has been named assistant general superintendent of the Diamond Refinery of Mid-Continent Petroleum Corp. at West Tulsa, Okla., serving with **Glen E. Wynn.**

° ° °

R. J. Bender of Sinclair Refining Co., Chicago, took along his French accent and several years of military experience in the French Army when he reported to Washington May 2 for assignment to active duty as lieutenant in the U.S.N.R.

"Chief" Bender has for the past 11 years been Combustion Engineer with Sinclair and also originated and edited the *Sinclair Firebox.* publication of which will be discontinued for the duration. Born in France, he fought in the first World War with the French Army, went to college after the armistice and then returned to the French Army for service in Morocco, Algeria and Tunisia.

After leaving the French Army, Mr. Bender came to the U. S. and later went to work for Sinclair. He is a member of the A.S.M.E. and the S.A.E. and has also worked with a chemical group in organization of techniques of the OCD in Chicago.

On the Lazybench

Hitch-Hiker's Lament

Nobody takes me anywhere—
There isn't anyone going there.

I stand on all the corners
Of Broadways, Firsts and Mains—
I can't figure where black markets
Get those ill-gotten gains
For all I see is hikers
With the same footaches and pains.
I'll have to get a parachute
And thumb my rides from planes.

Nobody takes me anywhere—
There isn't anyone going there.

—Marglio

° ° °

A noted geologist informs us that our oil deposits are a hundred million years old, as of May 19. Well, there's no fuel like an old fuel.

° ° °

The eagle eye of Federal Judge Stone of Madison, Wis., happened on the following little item, so he sent it on to us. We think it may give you an idea or two.

ANNUAL REPORT TO STOCKHOLDERS

Your officers are glad to report business over the past year has been vastly improved. In fact, we almost broke even.

Your company was able to get a little work done around the plant in 1942 by naming six vice presidents in charge of visits from tax agents, thus saving the higher executives the major amount of time. We built a new wing on the office, in which all data, facts, figures, reports, explanations and apologies demanded by the government may be prepared and turned out. The plant is now capable of answering 50,000 inquiries from Washington in a week. Plans are being drawn for an annex in which all summonses to congressional probes can be received, filed and catalogued without confusion.

The company has also appointed a vice president in charge of nervousness, a vice president in charge of apprehension, and two vice presidents in charge of grave misgivings.

Our cash position is strong, due to a new system of loose leaf, loose thinking and loose figuring bookkeeping, now quite the rage. We think this means a lot of good clean fun until we change auditors.

Summary: The general outlook is good. Car loadings are doing nicely. Boat loadings are firm. Auto loadings are improving. Bicycle loadings are important. Out stockholders will be glad to hear that, after suspending the custom over the lean years, we have decided to renew distribution of art calendars to all stockholders.

° ° °

A young man who had just been drafted was being examined at Grand Central Palace. The psychiatrist's assistant asked the routine question: "Do you go out with the girls?" The draftee shook his head and answered firmly, "No." The assistant called the psychiatrist, who repeated the question. Again the answer was, "No." "Why don't you go out with girls?" the doctor asked. "Because," said the draftee, "my wife won't let me."

—*The New York Post*

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That Comprehensive That Complete That Accurate

Directory of all oil and government war agency men who are active in the war effort.

3486 INDIVIDUAL NAMES of oil and government men

274 WAR AGENCY and OIL ORGANIZATION NAMES

These are the names that You want in a Hurry

—Names that your secretary needs with the addresses;

—Names that your telephone operator wants, with the phone number and extension number;

—Names your district and branch men and your department heads and their secretaries need.

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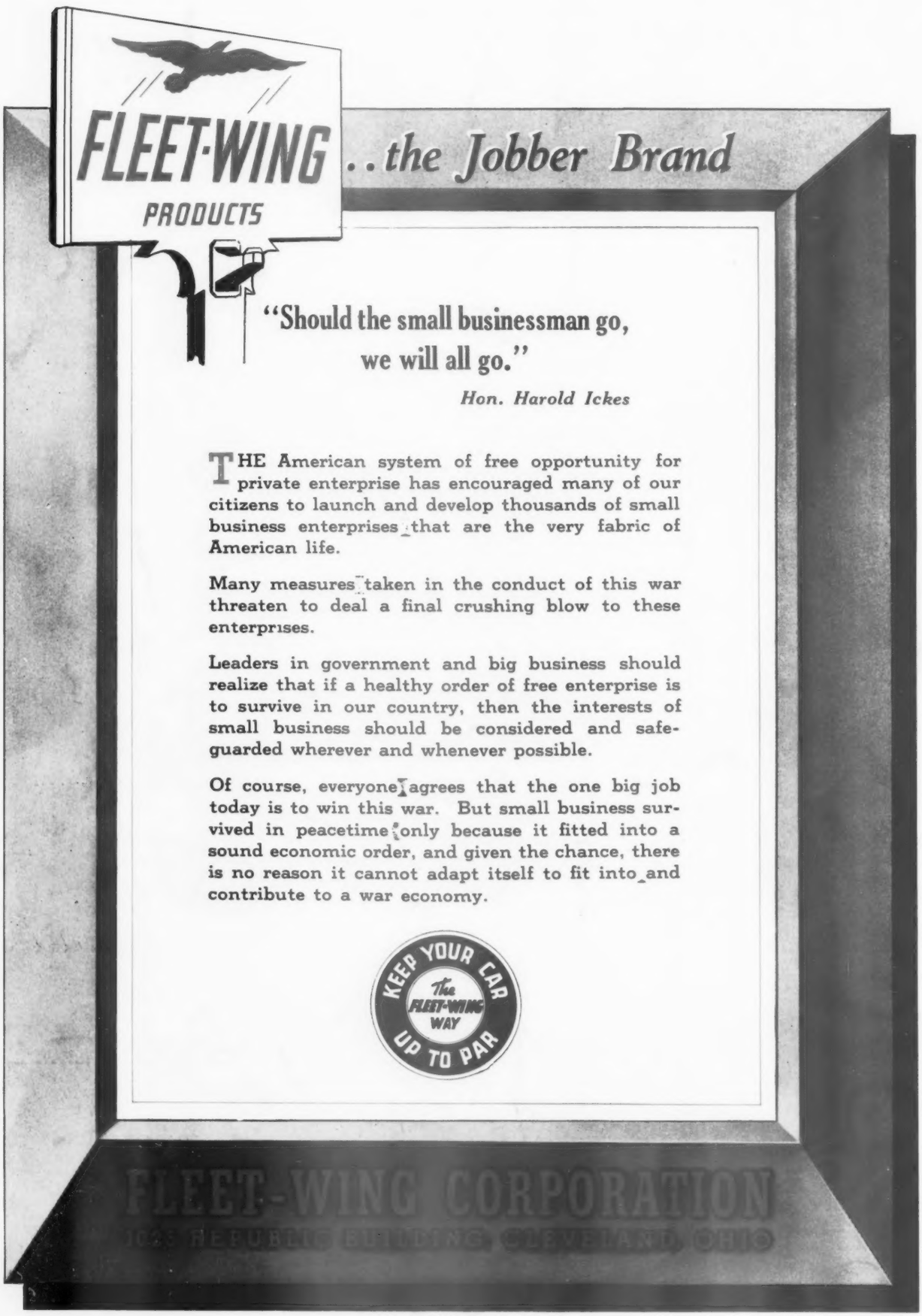
FLEET-WING
PRODUCTS
..the Jobber Brand
"Should the small businessman go, we will all go."
Hon. Harold Ickes
THE American system of free opportunity for private enterprise has encouraged many of our citizens to launch and develop thousands of small business enterprises that are the very fabric of American life.
Many measures taken in the conduct of this war threaten to deal a final crushing blow to these enterprises.
Leaders in government and big business should realize that if a healthy order of free enterprise is to survive in our country, then the interests of small business should be considered and safeguarded wherever and whenever possible.
Of course, everyone agrees that the one big job today is to win this war. But small business survived in peacetime only because it fitted into a sound economic order, and given the chance, there is no reason it cannot adapt itself to fit into and contribute to a war economy.
KEEP YOUR CAR
The FLEET-WING WAY
UP TO PAR
FLEET-WING CORPORATION

TECHNOLOGY DEPT.

NATIONAL PETROLEUM NEWS

Monthly Technical Section Devoted to
REFINERY MANAGEMENT and PETROLEUM CHEMICAL TECHNOLOGY

JUN 5 - 1943

Volume 35 | June 2, 1943 | Number 22

Wartime Conversion of Fluid Catalyst Process Increases Supply of Aviation Gasolines

OPERATION IS AUTOMATIC—Reading an outside control instrument at Standard Oil Co. of Louisiana's fluid catalytic cracking plant at Baton Rouge. Operation of the unit is entirely automatic, mechanisms controlling the ratio of catalyst flow to oil flow, flow of catalyst to regeneration, and the temperature of regeneration. For a large unit only a few skilled technologists are required in the central control room. In the background is the structure which supports the reaction chamber, regenerator, cyclone separators and the maze of large diameter connecting pipes

By operating at higher temperatures and using different catalysts, good yields are achieved from varied gas oil charging stocks. Operations include single and two-stage cracking... P. R-251.

'HF' Alkylation Method Provides Special Handling for Catalyst

Changes in construction of pump stuffing boxes and valve packings required; also special means for handling acid from tank cars to tanks and for feeding it into the process ..... P. R-243.

How an Oil Company Can Size Up The Petroleum Chemicals Field

(Concluding article in the ABC series)

R. L. Wakeman and B. H. Weil

Factors to be studied include type of feed materials available; processing equipment now installed; location of economic markets and capabilities of company personnel..... P. R-264.

Machine Shop Has a New War Job: Repair of Refinery Pumps

New parts fabricated by conventional equipment from salvaged material, including used alloy still tubes made into inner liners. Metallizing and welding used in maintenance repairs.... P. R-245.

6 Ways to Save Heat Exchangers In Plant Design, Operation

To aid in conserving this critical equipment, manufacturers suggest practical methods for providing minimum essential requirements for new plants and for reclaiming and maintaining exchangers now installed..... P. R-248.

Mass Spectrometer Provides New Analytical Tool for Refiners

Instrument developed for atomic and molecular research is found by oil company to provide a new quantitative method for determining light hydrocarbon components of feed stocks..... P. R-258.

High-Vacuum Rectifying Column Uses Multiple Redistillation

R. M. Shaffner, J. R. Bowman, James Coull

Still described which incorporates new design of column for securing compounds of higher purity than with present conventional design. P. R-272.

C. R. Williams

Studies Field Tests of Properties Of 'Wet' Gas Under High Pressure

● The High Pressure Gas Division of the Natural Gasoline Assn. of America, headed by vice-president C. R. "Dick" Williams, Corpus Christi, is responsible for much of the research being done on testing of "wet" natural gas under high pressures. This work in turn bears forcefully on conservation measures and operation practices in connection with cycling operations. Mr. Williams is manager, Oil & Gas Division, The Chicago Corp., cycling project operators. He is considered an outstanding authority on both field and plant phases of cycling projects.

Mr. Williams, 36-year old chemical engineer from University of Oklahoma, started in the oil business as chemist for Continental Oil Co. From 1936 to 1942 he was assistant manager of Conoco's Natural Gas and Natural Gasoline Division, leaving it to accept his present position with The Chicago Corp. He is married and has 2 sons.

REFINERY MANAGEMENT *and* PETROLEUM CHEMICAL TECHNOLOGY

June 2, 1943
Volume 35
Number 22

A MONTHLY TECHNICAL SECTION OF NATIONAL PETROLEUM NEWS *incorporating International Petroleum Technology*

720.3
729.7

Special Catalyst-Handling Equipment Provided in 'HF' Alkylation Plant

MANY plants designed to produce alkylate for use in 100-octane aviation gasoline, and employing anhydrous hydrogen fluoride as catalyst, are being rushed to completion in various parts of the country. Others are already producing commercially or are undergoing final acceptance tests. One of the first commercial plants to make alkylate with hydrogen fluoride as catalyst is being operated by Phillips Petroleum Co. "somewhere in the Southwest." Government representatives and a selected group of petroleum company technologists and engineers were shown through this plant early this year, in order that experience gained might be used to promote increased output of aviation grade gasoline in other plants.

The properties of anhydrous hydrogen fluoride, or hydrofluoric acid, as an alkylation catalyst have been widely discussed (1, 2, 3, 4).

Range of Feed Stocks

There is a wide range in the selection of feed stocks used, one of the requirements being that they contain both olefin and paraffin hydrocarbons. A charge stock which is suitable for aviation alkylate production, in light of present knowledge, appears below.

Suitable Feed for HF Alkylation (5)

	%
Isobutane	68
Isobutylene	8
n-butylene	13
Butane	10
Pentane	1
	100

In general, the higher the ratio of C_4 hydrocarbons to all other hydrocarbons the better for production of satisfactory aviation alkylate. Obviously, the ideal feed would consist wholly of pure butylenes and isobutane, since the final product sought is essentially an isooctane. Indicative of the wide variety of acceptable feeds, ratios of isoparaffin to olefin of from 1:1 up to as high as 20:1 have been reported (1, 4). Isobutane should considerably exceed olefin for best results, but only a part of the isobutane is consumed, the remainder being recycled.

Generally, equipment to handle anhydrous hydrogen fluoride may be made of steel, copper, monel metal, or combinations (3). Usually, low carbon steel and copper are the materials of choice, dictated by price and obtainability; they may be cast or forged. Known plastics are said to be unsatisfactory for piping and containers. Castings are satisfactory if free of sand holes, slag, or sand inclusions. Welded fabrication is desirable, but all welds must be sound and free of slag.

If castings are used, careful inspections are imperative in order to avoid encountering difficulties later. Among the several inspection methods which may be employed is pressure testing, using a low-viscosity liquid and maintaining elevated pressure over long periods in order to detect spongy spots, pinholes, hairline cracks, and other defects (5). Use of X-ray examination may prove helpful, also.

Since both operating temperatures and pressures are ordinarily rather low—in the neighborhood of 100°F. and 100 lbs. per sq. in., respectively—it is not necessary to use thick-walled vessels. Should it be desired, however, much higher pressure may be used, requiring appropriate construction. In general, only sufficient pressure to assure maintenance of liquid-phase operation is said to be necessary

Special construction of pump stuffing boxes, special valve packings and special gaskets are required because of the exceedingly reactive nature of hydrogen fluoride. However, standard types of recording and control equipment with minor modifications are used.

Safety in Handling HF

One important consideration is that the design and construction of all equipment handling the acid and its mixtures with hydrocarbons prevent leakage, blow-outs or spillage. When reasonable precautions are taken hydrogen fluoride is not an unusually hazardous industrial material. In this connection, while hydrogen fluoride is listed as a hazardous chemical, it involves no more risk than tetraethyl lead or sulfuric acid, to name only two commonly used members in that classification.

Plant operators should wear close fitting

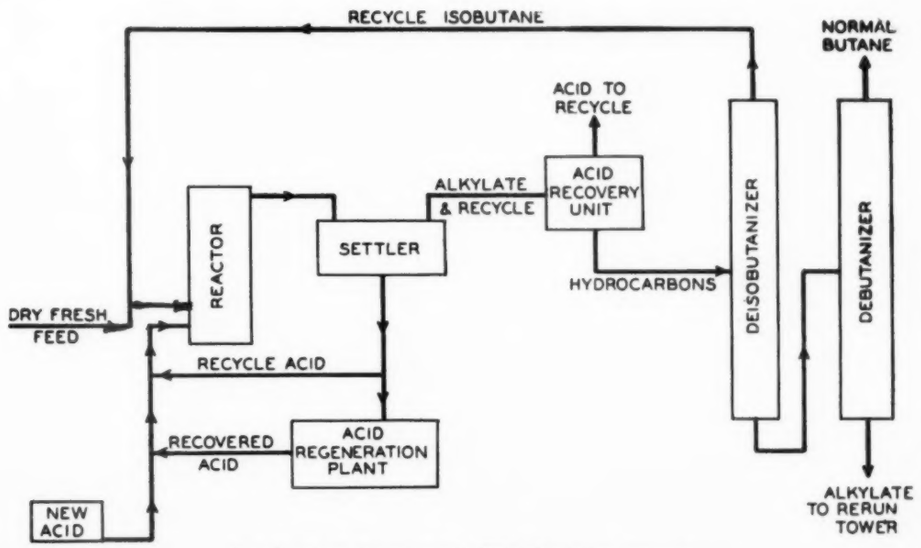

Fig. 1—Flow diagram of "HF" alkylation process

caps, face shields, tightly-buttoned rubber coats of the "double-breasted" type and rubber gloves where there is possibility of their coming into contact with the acid. Shoes having synthetic rubber soles are ordinarily used, but under some circumstances rubber boots offer more complete protection and should be available.

In Phillips' plant, where equipment was designed for the dual purposes of personnel safety and processing efficiency, there have been no serious accidents reported and the practicability of using "HF" commercially is thereby demonstrated.

Process Described

Dry, fresh feed is admixed with approximately an equal volume of anhydrous hydrofluoric acid and charged to the bottom of a reaction chamber where pressure and temperature are of the order of 100 lbs. per sq. in. and 100°F. respectively (*See Fig.* 1).

The reactor contains a heat exchanger using water as coolant and an agitator mechanism. The heat exchanger is necessary since the reaction is exothermic, and higher yields of alkylate are obtained if the mixture is maintained in an emulsified state by continued agitation. While no specific dimensions may be given by reason of secrecy requirements, the reactor must be small enough to permit maintaining sufficient agitation and cooling and large enough to provide adequate contact time for the reaction to go to completion. Pressure is used to assure liquid-phase conditions throughout the reaction.

Effluent from the reactor contains, depending on feed, inert hydrocarbons, alkylate, unreacted isobutane and the catalyst. The product stream from the reactor is charged to a settler, where the liquid separates into two phases: acid and hydrocarbon. From the settler, the acid phase is returned to the reactor and the hydrocarbon phase, which contains some dissolved hydrogen fluoride, is sent to the acid recovery unit. In the acid recovery unit the hydrocarbon stream is freed of its hydrogen fluoride content. The recovered "HF" is recycled along with the acid from the settler. The acid-free hydrocarbons are then sent to a fractionating system.

Further processing is simply a cleaning up of the alkylate from unreacted constituents and fractionation to aviation alkylate specifications. This is obtained through successive deisobutanizing, depropanizing (not shown on flow sheet), and debutanizing in the conventional manner by suitable fractionation. The isobutane recovery is recycled in the raw feed; the propane and normal butane are usable as liquefied petroleum gases or for further processing.

The alkylate is charged to a re-run tower for fractionation to aviation gasoline specifications; the small quantity of "heavy" alkylate produced is utilized in motor fuel blends.

Equipment Sidelights

There are two interesting sidelights on handling the catalyst and materials containing it, both dictated by safety and processing needs.

The acid is displaced by means of compressed gas from railroad tank cars directly to steel weigh-tanks, doing away with a pump for unloading purposes. Air is also used in a similar manner for injecting catalyst into the feed. The piping on the weigh-tanks is provided with welded joints—to preclude leaks—and the piping itself deflects when the tanks move upward or downward as they are filled or emptied. By means of the weigh-tanks, the amount of acid going to process—and consumed or lost—is determined.

Pumps and valves handling hydrogen fluoride, or material containing it, have a special type of stuffing box or mechanical seal which will prevent leaks and resist the acid. Some designers are said to use a resistant metal foil, and others an asbestos packing which may be impregnated with "Vistanex" or one of the synthetic rubbers (neoprene has been approved by Manufacturing Chemists' Assn. (6) for gaskets). In pumps, sealing rings are widely used. These may be backed up by springs and held in place by fluid under a pressure higher than process pressure. The fluid also may function as a lubricant and coolant if fluid is circulated through the bearing rather than dead-ended to it. Various types of mechanical seals are described by Taylor (7) in recent article, should the reader desire more detailed treatment of this subject.

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Modern solvent dewaxing plant. (Photo from Lummus Co.)

Wartime Repair of Refinery Pumps

Machine Shop Fabricates New Parts in One Oil Company Conservation Program; Cast Steel Liners Kept in Stock and Liner of Required Material Inserted as Needed; Old Chrome Alloy Still Tubes Used for Pump Interliners Give Increased Liner Life

ONE large refining company, forced by necessity to rebuild, repair and maintain its own pumps without benefit of manufacturer's replacement parts during the wartime emergency, reports it has not bought any pump parts except bearings for more than a year. This company states that, if this program of "making 'em over" had not been instituted, its refining plant would be down much of the time.

Through ingenuity and necessity this refinery has developed a program of maintenance repairs which produces the needed parts and at the same time uses materials accumulated around the refinery rather than new, critical metal. In some cases the bill of materials for homemade parts is not as great as for new parts from the manufacturer, because salvaged metal is made to do, including discarded alloy still tubes and old boiler plate.

It is not necessary to have a whole pump factory to do this work, company officials declare. In the machine shop, conventional equipment is augmented by one large punch press and a number of home-made jigs developed to make the work easier and fabricated from whatever material is handy. "It is only by welding, machining and metallizing that we keep going", the company's mastermechanic declared. "If we can't buy it, we have to find a way to make it—and, after all, we do have a war on."

According to the mechanical department's experience, valves, rods, rings and liners are the most frequent sources of trouble in reciprocating pumps. Packing sleeves are the cause of most shut downs in centrifugals, with damaged or worn impellers running a poor second. Other troubles, common to both types of pumps, include corroded pump nozzles, broken casings, worn lantern-rings, cracked flanges on suction or discharge lines, and damaged bearings. Occasionally a pump will be completely wrecked through misadventure and brought in for rebuilding.

The work of repairing a completely wrecked centrifugal pump used on water service now is facing the repair department. This pump was damaged by over-running itself, through excessive speed and vibration. The case was broken in many places, cracked in others; the bearing seized and galled; the governor damaged; some of the impeller blades are missing and others are bent or broken. In ordinary times, this pump would be consigned to the junk heap after a single glance. Under present conditions however, the master mechanic expects to return this pump to "as new" condition within a few weeks by dint of welding, metallizing and fabrication of such parts as are damaged past all repairability.

In fabricating the new parts, the old and damaged ones will serve as patterns. It is not the practice to have elaborate machine drawings of the work in progress; the engineering department is busy too, and preparing drawings consumes much time.

New Liners

New liners for reciprocating pumps are fabricated from bronze, brass, cast iron and cast steel. For most types of pumps this company owns, patterns have been made and are kept handy. As need for another liner develops, the patterns are sent to local foundries for casting in the appropriate metal, since the company does not maintain a casting floor. However, it is frequent practice to make a liner out of cast steel no matter the service, since an inner lining of the required metal can be inserted by shrinking or brazing in place. When the rough castings are received from the foundry they are put in a lathe for machining to finished dimensions; then placed in the warehouse against need. It is generally the practice to have several homemade liners in stock at all times to reduce down-time when replacements are necessary. This is especially the case where there are no stand-by pumping facilities available.

Old 4-6 chrome molybdenum alloy still tubes, torn out of furnaces when they erode past safe limits or become cracked, are salvaged and used for pump interliners. All that is necessary is to bore out the old liner (or a new home-made one) so that it will take the tube, and bore out the alloy tube to proper inside dimension. This is pressed into the outer liner, or it may be welded or brazed in place, sometimes by plug-welding. This not only gives a lower mechanical friction factor to the pump, but is resistant to many forms of corrosion. If tubes of higher chrome-molybdenum content are available, they are utilized in the same way.

This same practice is used in lining salvaged high pressure fittings. The old alloy tube is bored to proper size and properly mitered to fit the tee, cross or elbow before it is inserted. The joints then are welded and made integral with the flange face, which usually is also in need of attention. The face is grooved and machined flat, and is then ready for service. Valves can be treated in a similar fashion, the gate and seat properly built up and, if desired, surfaced with the same alloy by welding.

If for some reason it is not desirable to use an alloy inner lining for a pump liner, the alloy may be deposited by metallizing providing the liner is not smaller than 6 in. inside diameter. The proper attachments to conventional metallizing equipment for this work have been developed by some of the metallizing companies. Pistons can be metallized with satisfactory results.

For a description of metallizing technique, the reader is referred to 2 articles which have appeared in these pages recently*, and also to the manufacturers and distributors of metallizing equipment and supplies.

Maintenance Savings

The case of a hot oil pump may be taken as an example of preventive maintenance as practiced by the refiner mentioned earlier. It was formerly necessary to repack these pumps every 800 hours to stop leaks, operating conditions being in neighborhoods of 900°F. temperature and pressures ranging from 300 to 500 lbs. per sq. in. The area of excessive wear was occurring in the middle third of the cast steel plunger. New plungers are not available and it was growing exceedingly difficult to get hard steel tubing which could be bored to size and pressed on the plunger. So it was decided to resort to metallizing, replacing the packing with hard fiber rings.

Accordingly, the worn part of the plunger was first turned down to a depth sufficient to eliminate the "waves" caused by wear, then prepared for metallizing according to conventional practice. Metallizing is done with a self-hardening stainless steel, the surface being ground and lapped to finish dimensions.

Fiber rings may be made by cutting an appropriate thickness from any good fiber tubing, of which there are many on the market. The

*NATIONAL PETROLEUM NEWS *Technical Section*, March 3, 1943, p. R-102-4; Ibid, April 17, 1943, p. R-185-87.

exterior (or interior, depending on where it is used) should be grooved and a piece of spring brass rod inserted to provide the necessary tension.

One pump treated in this manner has run 6000 hours before repacking was necessary; it is now more than 2000 hours on its second lap without further attention. Two reasons for this increased freedom from maintenance are given, (1) The fiber rings, being so much softer than the stainless steel surface which they contact, do the wearing instead of the metal surface. This in turn prevents possible scoring and "waves" in the plunger, which in turn causes that much less wear on the ring. (2) The metallized surface is porous, absorbing oil instead of exhibiting a tendency to "wipe dry" as it passes the ring or packing; this results in a continuous lubricating effect that is difficult to secure otherwise.

A third effect also may be postulated. The stainless steel surface is capable of taking a much higher polish—"slicker finish"—than the usual steel surface. This results in a lower coefficient of friction between metal and packing, less wear is observed, and power cost may drop slightly.

Even in reciprocating pumps using alloy-steel liners, a much longer liner life is noted with fiber rings. Some of the company's records indicate liner life may be 2 to 6 times greater if the fiber rings are used exclusively, whether the liner metal is brass, cast iron, or steel.

Centrifugal Pump Repairs

Another case of a major maintenance operation on pumps involves centrifugal pump which had lost more than 30% of its original efficiency. Examination revealed the suction vanes on the impeller were badly worn, and the wearing sleeves were in a similar condition. The damaged impeller was obviously caused by some foreign body entering the pump; the grooves on the wearing sleeves were to be expected, considering the service life of the pump.

A new impeller, costing $155, was simply not to be had; delivery on new wearing sleeves could not be promised immediately. Therefore, it was decided to attempt home-made repairs at once.

Accordingly, the worn vanes were built up with bronze by electric welding, then machined to their original dimensions. The impeller then was rebalanced dynamically so that it was vibration-free under operating speeds. The repair of the wearing sleeves was not so simple a matter, since wear was so great as to make it doubtful how long they would last. It was decided to use the worn parts as patterns for new ones.

Low-carbon steel bar stock was selected as the base material, complete new sleeves being fabricated. The wearing surface then was prepared for metallizing, metal deposited in this case being high carbon steel. (Stainless steel can be used if desired.) This worked so well that the practice is being used on all wearing sleeves, although it is not usually necessary to refabricate a "new" sleeve. Rather, it is metallized with either stainless or high-carbon steel.

Some centrifugal pumps are constructed with a non-removable wearing sleeve. In this case the worn portion is turned down sufficiently to clean up the surface, and new metal deposited through welding or metallizing. It may be desirable to deposit a low-carbon steel by welding, especially if the wearing has been excessive. However, the final surface deposited by metallizing and finished by grinding to service dimensions.

Reconditioning Rods & Shafts

In this connection, the International Nickel Co. has published a brochure† in which 2 methods of reconditioning worn monel or nickel steel pump shafts and rods are advocated. The first is by machining and refinishing, without deposition of additional metal; it is not recommended where "whipping" or "bending" of the piece is evident, or where wear is sufficiently great that machining will reduce the finished dimensions past a safe value.

The second is by rebuilding the worn section to its original size by welding, metallizing, or electroplating. Three advantages and one disadvantage are stated for renewal through electroplating. Electroplating is slower than repair by welding or metallizing, but it eliminates possibility of heat distortion and warpage of the part; it produces a dense, fine grained deposit that can withstand any corrosive condition under which solid nickel can be used; and it makes an extremely wear-resistant surface, for the hardness of the plating can be controlled to develop tempers ranging up to several times the hardness of the original pump rod or shaft.

A portion of this brochure dealing with the electroplating method states:

"After the worn section of the shaft has been machined, the surrounding area is coated with a "stop-off" lacquer or a special wax. These coatings prevent the nickel from depositing on the masked surfaces where it is not wanted, and confine it to the section which is to be built up. Finally, the worn section is cleaned and carefully etched by an acid treatment before plating.

"Immediately after the etching treatment, the electroplating operation is begun. The hardness of the deposit is controlled as desired by varying the plating conditions to produce any one of 3 regular tempers. 'Soft' ranges from 140 to 160 Vickers; 'Intermediate Hardness' from 230 to 260 Vickers; and 'Hard' from 395 to 500 Vickers or higher. (Vickers hardness values practically correspond to Brinell Hardness Numbers.) The growth of trees or berries on the ends of the electrode deposit may be eliminated by the use of thief rings.

"When the worn section is built up with the desired thickness of nickel, the method of finishing it to final size depends on the hardness of the plating. If the plating is 'Hard', it should be finished by grinding. If the plating is 'Soft' or 'Intermediate Hardness', it can be readily machined . . . . There are 2 additional recommendations which are helpful in machining electroplated nickel—a soluble oil lubricant should be used and machining should begin at the center of the work for safer handling of the natural overgrowth of the 'berries' which deposit at the ends."

Other Material Conservation

This same oil company referred to above has an extensive salvage program in effect for conserving all fittings, valves, short length of pipe and tubing, flanges, return bends, etc.

Fittings, if badly corroded, are bored out until they are smooth; alloy linings made from discarded alloy still tubes are installed, and flanges are built up with stainless steel if required.

Valves are completely rebuilt if necessary. Holes in the body, or cracks, are repaired by welding; seats are reground or built up with weld metal before regrinding if necessary; gates are reground, or built up with weld metal before regrinding if necessary, but final refinishing awaits actual installation in a specific valve body, because an individual fit is required. If a new stem is required, it is made from carbon steel or alloy bar stock, or from old auto and truck axles if the latter are available.

Brass tube-sheets in condenser and cooler service, now exceedingly difficult to procure, are "made" by fluxing brass onto sheet-steel plate 1½ in. thick. This is done by wrapping a "rim" around the edge of the plate so that the rim will project from ⅛ to ⅜ in. Brass is deposited by welding, and the whole heated in a furnace until the "surface" is well-fluxed onto the parent metal. The sheet then is machined to desired thickness and bored to receive the tubes. It is possible to achieve the same effect through metallizing; also, the surface can be lead, zinc, or even stainless steel through this method. In the case of stainless steel, a thin sheet of the alloy may be plug-welded to the sheet steel.

Flanges are made from old or new sheet steel and boiler plate. Procedure is similar to that advocated in an earlier article in this conservation series‡ and will not be further discussed.

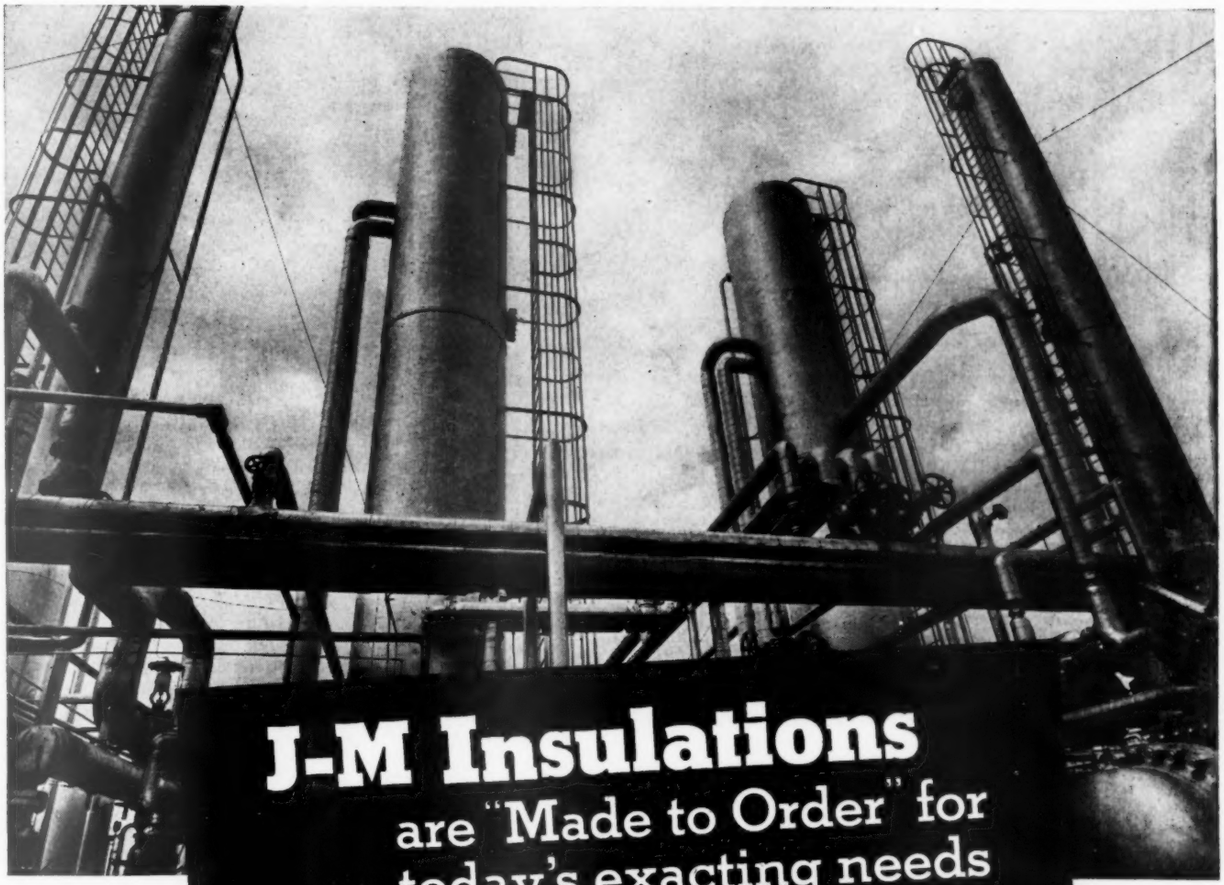
Short lengths of pipe are butt-welded to form longer lengths. Piping torn out of existing installations is carefully examined and unusable portions are cut out and sold for scrap. Return bends are cut off, repaired if necessary, and stored against future need.

Risers for bubble towers also are made from short lengths of pipe. A simple jig, powered by an old compressed-air motor salvaged from a decoking turbine, is used to make turning the work easy for down-hand cutting and to assure uniformity. Two risers are cut at a time with an acetylene torch, the cut-out portion between notches on the one riser coinciding with the raised notches on the other. This method of cutting makes for savings in both labor and material.

These risers may be cut to different lengths for installation on a warped bubble tray. Riser length is adjusted so that the tops of all bubble caps will be the same height above the liquid level on the tray. The actual liquid level on the tray will vary because the tray is warped, of course, but because riser height is compensated for this, the same liquid back-pressure will be maintained on the ascending vapors at all bubble caps on the tray.

†"How To Recondition Worn Pump Shafts and Rods", The International Nickel Co., 67 Wall St., New York, N. Y.

‡National Petroleum News, *Technical Supplement*, Oct. 28, 1942, p. R-348-350.



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Six Ways to Conserve Heat Exchangers In Plant Design and Operation

TO MEET the still critical situation in heat exchanger equipment for refineries and natural gasoline plants, manufacturers and refinery engineers suggest the following practices for plant designers and operators:

1—Design new plants for minimum possible heat exchanger surface and add additional exchangers when the present emergency is ended.

2—Simplify and use standard design for new exchangers.

3—Conserve critical materials in both new and reconditioned equipment.

4—Reclaim discarded heat exchangers.

5—Inspect this plant equipment more frequently.

6—Avoid overloading.

The care and operation of heat exchangers has always been a matter of great importance to refiners and natural gasoline manufacturers, for every plant has many installations. The great expansion in the aviation gasoline and synthetic rubber programs of the oil companies and the wartime requirements of other industries, coupled with the scarcity of materials, has aggravated the problem of securing adequate new equipment. For example, one manufacturer stated that capacity to make heat exchangers in 1942 was sufficient to handle $80,000,000 to $100,000,000 worth of business annually. Government estimates place the demand made on manufacturers during the 7 months from July 1, 1942, to Jan. 30, 1943, at $325,000,000, indicating that many will be unable to fill additional orders for many months.

In general, shell-and-tube type exchangers are said to be more difficult to secure than the atmospheric and submerged types. This is because the former is not a standardized piece of equipment, but rather is designed for the individual requirement. Hence this type usually is not readily adaptable to other service without extensive redesigning and rebuilding. While atmospheric and submerged type sections are also built for a particular service, their design is not so critical as to preclude shifting to other service. Moreover, since lesser relative quantities of critical materials are required in their manufacture, some plants are now said to be able to accept orders for this type as rapidly as tubing can be secured.

The 6 suggestions given above for relieving the critical situation in this equipment are expanded as follows, the data being secured from refinery designers and construction engineers and plant operators:

1—Use less new heat exchanger surface where possible, even at a sacrifice in overall fuel and heat efficiency.

By "underdesigning" the exchanger capacity for new plants, marked savings in this equipment can be attained. This will permit the unit going on stream at an earlier date because of more prompt delivery of the most essential equipment and also the burden on the manufacturer will be lightened.

For example, instead of designing heat exchangers to cool a naphtha down to perhaps 80°F., it might be better to cool it only to 100°F. The same would be true for other distillates. Advantage is taken here of the law of diminishing returns, for with possibly 4 exchangers in series, coolant flow being countercurrent, the greatest temperature difference would exist between coolant leaving at its highest temperature and entering liquid (or gas) at its highest temperature. Therefore the first two exchangers would transfer the most heat at the point of steepest gradient. At all other points the temperature gradient is less steep and likewise the actual amount of heat transferred. Yet, as normally designed, the exchangers may all be the same size and contain the same amount of critical materials.

This practice of designing for less heat exchanger surface than normally obviously will affect the heat balance of the plant. Incoming crude, feed water, or cracking stock charge will not be preheated, or not preheated to so high a temperature as conventional practice calls for. As a result, more fuel will be required for heating the various stocks, but this may be preferable to encountering delays in operation caused by long waits for exchanger delivery. Moreover, when the wartime shortage is relieved, additional exchangers can be installed.

2—Simplify designs of new exchangers so that manufacturers can use their plant capacity to best advantage.

While this applies to all types of exchangers it is especially important on shell-and-tube types. The War Production Board's standards bind all manufacturers, but there is still considerable customer resistance to accepting these standard designs, manufacturers say.

Elimination of floating-head construction, if not imperative for meeting temperature or cleaning requirements, is an important factor in reducing quantity of materials required. Savings of 60% to 75% in material costs are possible this way, too. Fixed tube-sheet and hairpin-type bundles instead of floating-head type will reduce labor from 50 to 60%, another important cost item, manufacturers say.

If it is possible to use an atmospheric or submerged-type section, it is advisable to do so. Deliveries will be more rapid, as less materials and labor are required and less designing necessary. Costs also are lower than for shell-and-tube type.

3—Conserve critical materials in both new and reconditioned equipment, even at a sacrifice in operating life.

In this connection use of plain carbon steel tubing instead of Admiralty brass, copper, stainless steel and other alloys is mandatory by order of the WPB where corrosion resistance does not make their use imperative; permission of the WPB is required to use brass and stainless steel. Forged steel flanges are difficult to secure; manufacturers advise using cast steel and steel plate slip-on flanges or homemade welded flanges wherever possible instead.

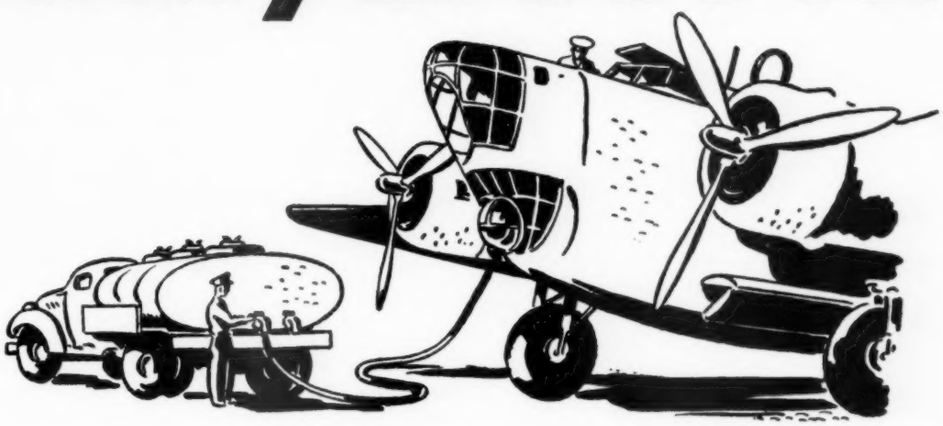
Frequently, use of steel instead of brass and other alloys for exchanger parts means reduced life for the equipment, but since steel is a less scarce material, replacements will be available when necessary.

4—Reclaim discarded exchangers wherever possible.

It is frequently possible to rebuild old shell-and-tube type exchangers for new service. Sometimes this will be at greater expense than new equipment, but delay in getting the plant into operation is avoided. Or, the materials

Typical horizontal atmospheric-type sections in a cooling tower and coil shed. (Photo from Joseph A. Coy Co., Tulsa)

IT TAKES *THOUSANDS* OF *TONS* of Anhydrous HF



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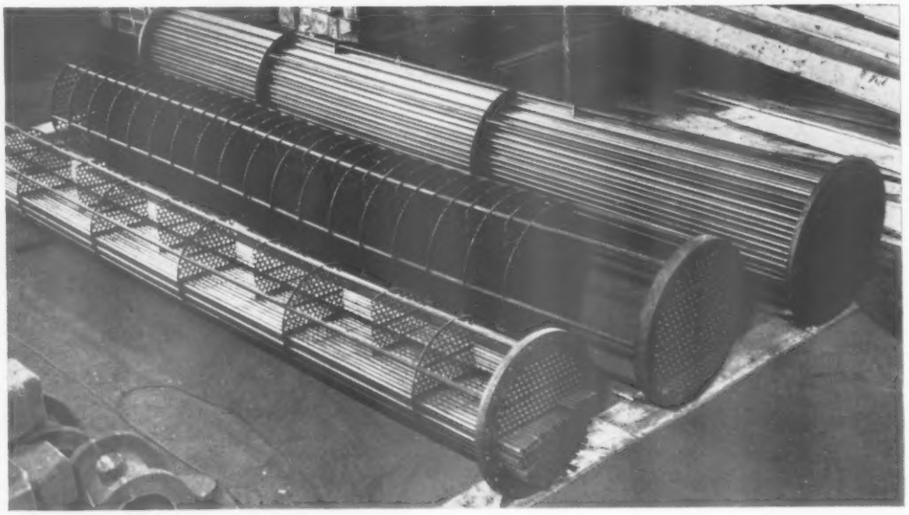
in an old exchanger, in conjunction with small amounts of new material, can be used to make a "new" exchanger for an earlier delivery date than would otherwise be possible. It now takes 40 to 90 days to secure delivery of all necessary new material for exchangers of the shell-and-tube type, it is reported.

One heat exchanger manufacturer reports frequent receipts of discarded tubes, shells and headers from his regular customers for use in filling their orders. In this connection also, he stated that currently it is as difficult to secure plate steel as it is to get delivery on tubing, while several months ago the bottleneck was plate and still earlier tubing. If a plant's discarded equipment piles have not already been turned in to the national salvage drive, they should be combed carefully for discarded heat-exchanger parts, this manufacturer suggests.



Heat exchanger bundles in fabricator's shop. Extreme right is a reboiler bundle, the other two are partly-completed, floating-head exchanger bundles, showing details of baffling and tubing (Photo from Joseph A. Coy Co., Tulsa)

5—Set up an inspection schedule for more frequent and thorough checking of all exchangers in operation.

This will provide for the proper cleaning of tube bundles and may forestall serious corrosion damage to equipment. It has been the practice in many plants to balance labor cost required to tear down and clean exchangers against the less frequent cost of replacing or repairing damaged equipment. In ordinary times, manufacturers say this may be an important consideration but now that it is difficult to get replacements it is important to inspect and clean to secure maximum life of the equipment even at a higher labor cost.

Frequent cleaning will also pay dividends in maintenance of exchanger efficiency. As the exchanger surface becomes coated with scale or other material, the heat transfer rate drops sharply and pumping costs may spiral upward as friction from restricted passageways increases. Tubes also may become so clogged as to be next to impossible to ream out.

Inspection at frequent intervals usually will readily reveal the beginning of damage from corrosion, permitting prompt action to prevent additional damage through appropriate treatment to remove or reduce the effect of the offender. Sometimes, however, the cure may be more expensive or difficult to attain than to endure the effects of the disease, refiners point out.

Exchanger manufacturers say it is difficult to use metallizing to remedy this trouble, because of the large and intricate surfaces; if corrosion is on the inside of the tubes, of course metallizing would be out of the question. To metallize a tube bundle requires that each tube be individually treated, possible only during installation and liable to damage when the tubes are being driven in and faced to the headers.

6—Operate exchanger equipment as closely as possible to design conditions as overloading tends to materially decrease life of the equipment.

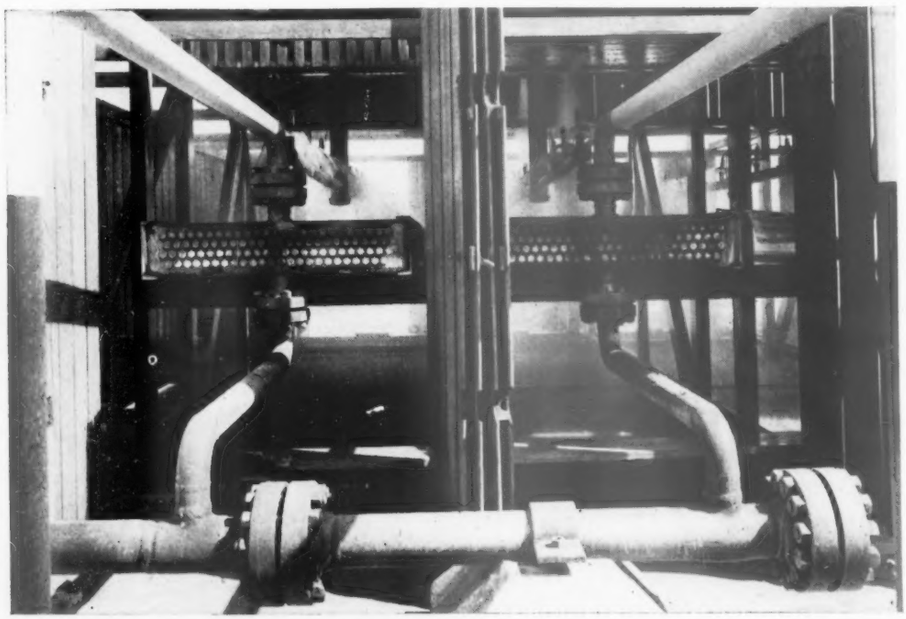
This precaution needs emphasis, refiners and manufacturers agree, for the heat balance in plants is being affected by the altering of yields in the wartime program and conversion of units to make new products.

One of the dangers caused by overloading, which usually takes the form of increased velocity of flow in the equipment, is that erosion rather than corrosion may come into being while the exchanger may not have been designed to resist this factor. Or, the point where corrosion is expected to occur in the equipment may be shifted to some other point, as heat-distribution balance is changed by the increased flow. It may be that the exchanger was "protected" at the point of normal corrosion when it was built; with corrosion area changed, the advantage of this "protection" is lost.

Still another danger to which increased flow may expose exchangers is that existing corrosion may take the form of a protective, adherent film over the metal, but this may be scoured away as rapidly as formed if flow is increased—thus the metal may be entirely eaten away.

If the exchanger has been shifted to another service, or service temperatures are increased, it will be well to make sure that the safe operating limits of the exchanger metals are not exceeded. In the case of Admiralty metal, for example, this is taken to be 450 to 500°F.; adequate for naphtha coolers, but perhaps entirely inadequate for fuel oils or cracking stock.

To these six points, perhaps a seventh may be added: Avoid carelessness. One exchanger manufacturer told the writer of a recent rebuild job caused entirely because the operator forgot to drain off the cooling water during a shut-down in below-freezing weather. The tube bundles were both crushed and "scrambled", headers were bulged and warped, and even the shell was ruptured in several places. "It was a mess," he commented.



Close-up of horizontal atmospheric-type sections, showing details of headers and piping. (Photo from Joseph A. Coy Co., Tulsa)

Producing Aviation Gasoline By Fluid Catalytic Cracking

BY using a suitable catalyst and cracking more severely at high temperatures, aviation gasolines containing large amounts of the desirable aromatic hydrocarbon compounds are now being produced by the Fluid Catalyst process of the Standard Oil Co. (N. J.).

At the same time, increased quantities of butylenes and other light fractions required as raw materials for the synthesis of aviation gasoline blending materials, synthetic rubber and toluene can be obtained. These results can be achieved from widely different gas oil charging stocks.

The Fluid Catalyst process, the first to be developed to apply the principle of continuous circulation of the catalyst as compared with the fixed bed catalytic process, was originally operated to produce high octane motor gasolines. However, some 30 plants are now under construction in this country to produce aviation gasoline, of a wide range in charging capacity. In addition, some commercial units already have been producing aviation gasoline for several months, thus contributing substantially to the nation's wartime needs. The process is available, by licensing, to refiners participating in the aviation gasoline program.

Development work on the process for producing motor gasoline as the main product was discontinued even before this nation entered the war. No important changes in basic equipment or design were found necessary to operate the process to make aviation gasoline, the principal change being higher cracking temperatures and the use of synthetic in place of natural catalysts. Fig. 1 is a flow diagram of the Fluid Catalyst process as developed by the Standard Oil Development Co. at the Bayway, N. J., refinery of Standard of New Jersey. The general principles of fluid catalyst circulation and the operation of the Fluid Catalyst process have already been described°.

Data on the characteristics of aviation gasoline obtained from the conversion of the process to supply products needed in the war program were presented in a paper by Standard Oil Development Co. technologists before a meeting of the Petroleum division of the American Chemical Society in Detroit April 15°°. These results were obtained from operations in a semi-commercial fluid catalytic cracking unit at the Bayway refinery. A variety of gas oil feed stocks were used which were typical of oils available to refiners in Gulf Coast, Mid-Continent and East Coast refining districts. The data given before the Society is reviewed here.

The production of aviation gasoline by Fluid Catalyst cracking can be carried out in a number of ways depending on such conditions at the individual refinery as type of charging stock, availability of hydrogenation and other equipment, and also on the specifications of the aviation gasoline product to be made. These methods include single-pass cracking; reprocess-

°"20-Story Cracking Plant Makes Aviation Gasoline by Fluid Catalytic Method", *Technical Section*, NATIONAL PETROLEUM NEWS, Feb. 3, 1943, p. R-56.

°°"Catalytic Cracking by the Fluid Catalyst Process", by E. V. Murphree, Standard Oil Development Co., New York; C. L. Brown, Esso Laboratories, Standard Oil Co. of Louisiana, Baton Rouge, La.; H. G. M. Fischer, E. J. Gohr and W. J. Sweeney, Esso Laboratories, Standard Oil Development Co., Elizabeth, N. J.

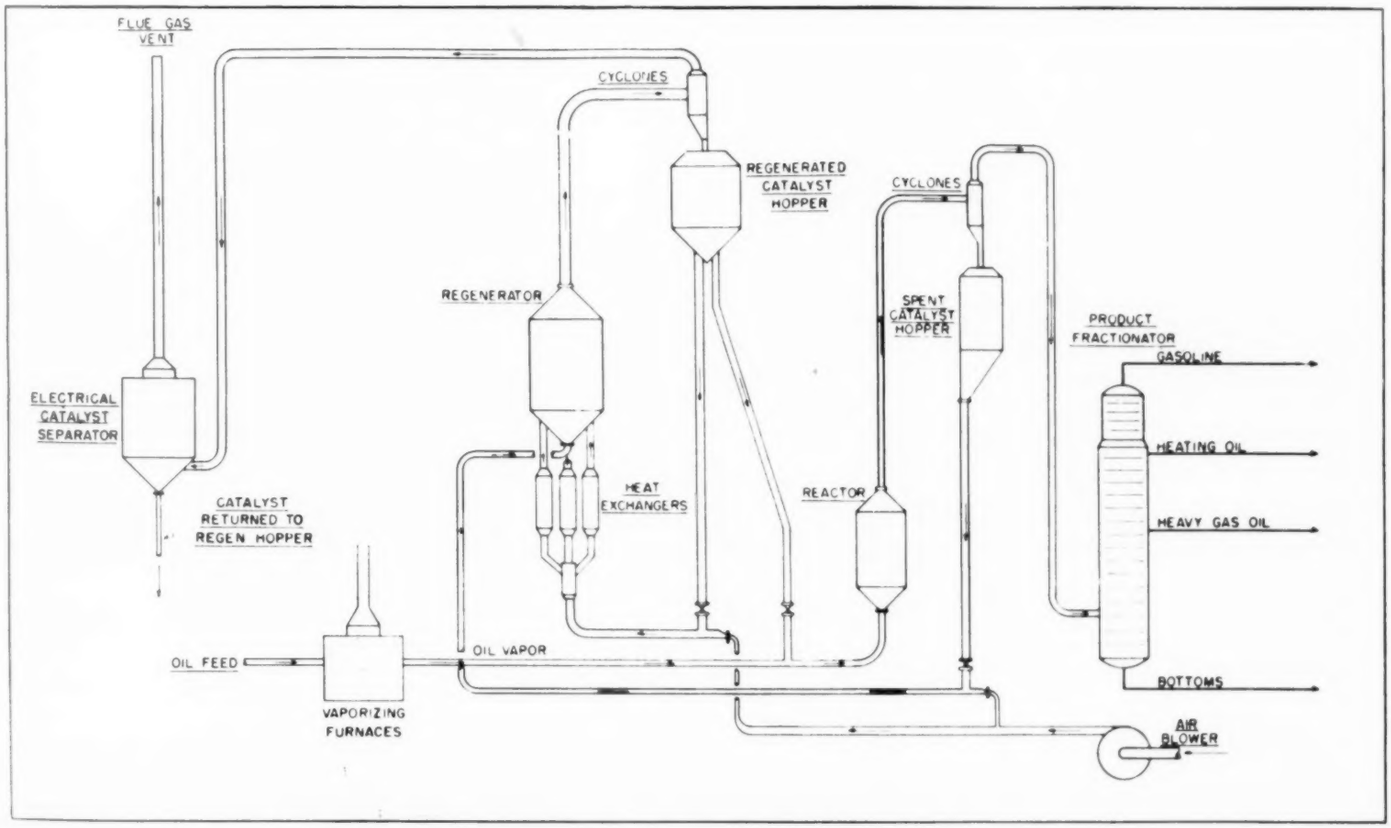


Fig. 1—Flow diagram of Fluid Catalyst cracking plant

ing selected fractions from the first-pass operation; and by further cracking of the entire product from the first operation, among other methods.

Single-Pass at High Temperature

In typical operations, single-stage cracking at higher temperatures than for yields of motor gasoline produces a gasoline containing considerable proportions of toluene, xylenes and the higher aromatics, in addition to high yields of olefins and isobutane suitable for alkylation. The lower boiling fractions from a paraffinic gas oil feed, while low in aromatics, have approximately double the olefin content of the heavier fractions. These lower boiling fractions may be treated further by hydrogenation for use in aviation gasoline blends. The fractions boiling above 225° F., being relatively low in olefin content but high in aromatics, can be used as blending agents without further processing.

Blending of the lower boiling material, after hydrogenation, with the higher boiling aromatic fractions as produced by cracking, provides an aviation base gasoline rating 96 ASTM Aviation with specification lead added, as shown in Table 1. It is significant that these results were obtained from cracking a paraffinic gas oil of a type available to refiners in many sections. It is indicated that considerably higher octane material could be produced were a naphthenic gas oil feed used as, for example, from a Gulf Coastal crude.

Where adequate hydrogenation facilities were available, another method in single-stage cracking by the Fluid Catalyst method would be to hydrogenate all the aviation gasoline, giving a product of materially higher octane number and with a similar boiling range.

Two-Stage Operations

Aviation gasoline material as originally produced may be subjected to further cracking. The second operation can be performed in the primary cracking plant or, in the case of a new unit, smaller reactor and additional fractionating equipment could be added to provide continuous operation. A loss in yield accompanies the improvement in product.

Characteristics of the gasoline produced by further cracking are shown in Table 2, as compared with the product from the first pass. The increase in octane number is brought about by the saturation and elimination of olefins in the lower boiling fraction and concentration of aromatics in the higher boiling fractions. This type of operation is considered practicable for a refiner where hydrogenation equipment is not available and where the supply of light blending naphthas is limited.

TABLE 1—Characteristics of Aviation Gasolines from One-Pass Fluid Catalytic Cracking, at High Temperatures
(From a Paraffinic Gas Oil Feed)

Aviation Stock	As Produced	Blend*
Gravity, °API	60.2	62.7
RVP, lbs./sq. in.	7.0	7.0
Aniline point, °F.	66	102
Bromine No.	63	8
Acid Heat, °F.	135	13
ASTM Distillation		
I.B.P., °F.	121	110
10%	141	139
50%	190	189
90%	292	288
F.B.P.	338	340
Octane Rating		
AFD—IC+4cc TEL	90.6	96

*Blend of hydrogenated light fraction and raw heavy fraction.

TABLE 2—Characteristics of Aviation Gasoline from Two-Stage Operations By Fluid Catalytic Cracking.
(From Paraffinic Gas Oil Feed)

Aviation Stock	As Produced	Second Stage Product
Gravity, °API	60.2	56.6
RVP, lbs./sq. in.	7.0	7.0
Aniline Point, °F.	66	64
Bromine No.	63	13
Acid Heat, °F.	135	27
ASTM Distillation		
I.B.P., °F.	121	108
10%	141	139
50%	190	210
90%	292	293
F.B.P.	338	324
Octane Rating		
AFD—IC+4cc TEL	90.6	97.0

Single-Stage at Low Temperature

By cracking at relatively low temperatures base gasoline can be produced for use without further treatment in aviation blends. Results of operations in the semi-commercial pilot plant indicate this method is particularly adaptable to naphthenic gas oils and results in a product high in leaded octane number. The gasoline produced from paraffinic gas oils was inferior in clear octane number to that produced from paraffinic gas oil in higher temperature cracking but ASTM Aviation octane numbers of 91-94 can normally be secured with 4 cc. of lead. Production of olefins is relatively small in this operation and yield is relatively high. A disadvantage is the small quantities of olefins available for alkylation feed. Table 3 shows typical products from this operation.

TABLE 3—Characteristics of Aviation Gasoline Produced by Single-Stage, Low-Temperature Fluid Catalytic Cracking.
(From Naphthenic and Paraffinic Gas Oils)

Aviation Product	Naphthenic Feed Stock	Paraffinic Feed Stock
Gravity, °API	57.6	67.7
RVP, lbs./sq. in.	7.0	7.0
Aniline Point	85	122
Bromine No.	10	20
Acid Heat, °F.	24	39
ASTM Distillation		
I.B.P., °F.	114	114
10%	140	141
50%	203	189
90%	273	274
F.B.P.	300	316
Octane Rating		
AFD—IC+4cc TEL	96.0	93.3

Using Outside Isobutane

One type of operation of the Fluid Catalyst process for the production of aviation gasoline where isobutane is available from outside sources is illustrated in Fig. 2. From 100 bbls. of gas oil charged plus 9.7 bbls. of isobutane there is produced 56.9 bbls. of aviation gasoline considerably higher in octane number than existing requirements. For this reason, it is possible to blend in 21.5 bbls. of virgin naphtha not in itself of sufficiently good octane number for direct use, to give a total of 78.4 bbls. of 100-octane aviation gasoline for each 100 bbls. of gas oil cracked. In addition to the aviation gasoline there are produced 6.6 bbls. of motor gasoline fractions and 35 bbls. of light fuel oils. The extraneous quantities of isobutane are required due to the fact the isobutane produced in the catalytic reaction is not sufficient to utilize all the C_4 and C_5 olefins produced.

Motor Fuel Production

Typical results from operation of the Fluid Catalyst cracking process to produce motor gasoline were also presented in the same paper before the American Chemical Society by technologists of the Standard Oil Development Co. and are given in Tables 4 and 5. These results were obtained in the semicommercial pilot plant at Bayway. Feed stocks typical of those available to refiners in the Mid-Continent, Gulf Coast and East Coast refining districts were used. These pilot plant results were checked by those from 3 large commercial units, the first commercial Fluid Catalyst unit having been placed in operation in May, 1942. Production of motor gasoline is normally obtained by single-pass cracking of distillate stocks, at lower temperatures than for aviation gasoline yields, and using a natural in place of synthetic catalyst.

In the operations for which results are given in Table 4, the same gas oil conversion conditions were maintained in the reactors, the conversion of feed gas oil being approximately 49%. Other desirable products from the motor gasoline operation are heating oil which can be cut directly from the gas oil as a finished product and propylene, butylene and isobutane fractions which are desirable raw materials in the production of aviation gasoline components and butadiene. Table 5 shows the characteristics of the motor gasolines and cracked gas oils produced by cracking the 4 types of gas oils shown in Table 4. Octane numbers of the gasoline range from 91.3 to 94.3 CFR Research without lead. The Coastal naphthenic gas oils are indicated preferable from the standpoint of octane number as well as yield of the gasoline produced.

Reaction temperatures for motor gasoline production range between 800 and 1000° F. but can be varied over a wide range. Temperatures for regeneration of the catalyst are normally between 1000 and 1200° F., it is stated. The pressure level can be held at the desired point. In operations for cracking gas oil, the pressure at the top of the reaction vessel is around 10 lbs. per sq. in. and the pressure at the top of the regeneration vessel substantially atmospheric.

Catalyst Recovery Satisfactory

In 5 months operation of a commercial unit for aviation gasoline production, maintenance of catalyst activity was satisfactory, it was stated in the paper presented before the American Chemical Society by the Standard Oil Development Co. technologists. At the end of the run the catalyst was found satisfactory for future operations and its use in the unit was continued. In operations generally, the recovery of catalyst has been satisfactory despite periods in which losses were higher than could be regarded as normal, due to faulty conditions in the dust collecting equipment. In the 5 months of opera-

A process goes to war

Codimer is a term applied to the product of polymerization of an olefin * * * with another olefin

That is how National Petroleum News defines one of the newer components of 100-octane gasoline, in the April 7 issue, and the article goes on to say:

One of several commercial catalytic polymerization processes for manufacture of polymer gasoline which can be converted to codimer preparation is that employing a solid phosphoric acid catalyst

It is the U.O.P. catalytic polymerization process that employs the solid phosphoric acid catalyst and it has gone to war—that's no news to Universal licensees

There are scores of U. O. P. poly units in American refineries How many of them have been converted to codimer production with the help of Universal refining specialists we can't tell you Nor can we tell you how much codimer they are making—those are military secrets

But we can and do tell you—that we'll be glad to help you get into war production, converting the units you have, so far as possible, to work for Uncle Sam And we know how

Our only business now is war business

Call on U. O. P.

OIL IS AMMUNITION—USE IT WISELY CARE FOR YOUR CAR FOR YOUR COUNTRY

Universal Oil Products Co
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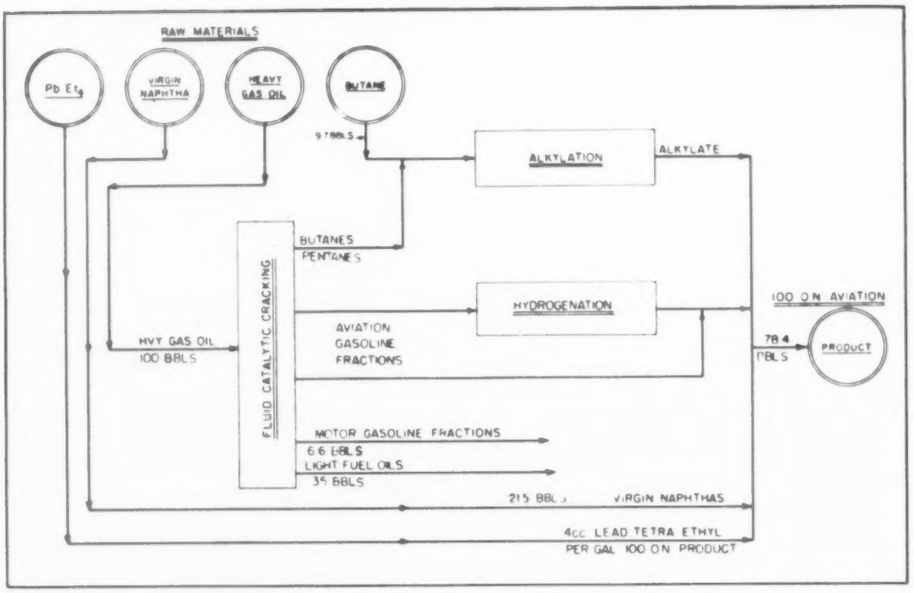

Fig. 2—Diagram of application of fluid catalytic cracking to aviation gasoline production where outside isobutane is used and virgin naphtha is blended with the product from catalytic cracking to achieve 100-octane gasoline

tion, actual catalyst loss averaged 2.27 tons per day, or about 0.41 lbs. per bbl. of feed. This figure includes the losses experienced in starting up the unit.

The unit was found to be in good mechanical condition following the 5-months run, it was stated, thus indicating that maintenance requirements will be low. Small mechanical changes are now being made in the dust collecting system and it is expected that with these changes catalyst loss from a large commercial unit will be around 1 ton a day.

Principle of Catalyst Circulation

The means by which circulation of the solid catalyst in a fluid mass is obtained was described in another paper presented April 14 at the general meeting of the American Chemical Society in Detroit by E. V. Murphree of Standard Oil Development Co.[°°°]

"The fluid catalyst operation represents a new method of carrying out industrial catalytic reactions," it was stated. "In its broadest sense it represents a new method of industrially handling solids and of controlling the temperatures of gaseous or vapor reactions. In this process the catalyst is used in the form of powder and is handled in such a way that it is maintained in a freely flowing or fluid condition at all times. In this form it can be made to flow like a fluid such as water and the process derives its name from this property of the catalyst.

"Circulation of the catalyst in large quantities between the reaction or cracking vessel and the regeneration vessel is accomplished without the use of any moving parts. This is done by application of the gas lift principle which is used for handling liquids. Build up of pressure to promote catalyst circulation is accomplished through the use of a standpipe containing catalyst of high density which provides a gravity fluid head against a leg of catalyst of lower density. The amount of pressure that can be built up depends only on the height of standpipe used."

More general applications of this principle of catalyst circulation was discussed as follows in this paper:

"The fluid catalyst principle has important application to controlling the temperatures of vapor or gaseous reactions whether a catalyst is required or not. In the case where no catalyst is desired an inert powder may be used to replace the catalyst. As has been brought out before, in vessels such as the reaction or regeneration vessel, in a cracking unit, the catalyst although of relatively high density is in an extremely turbulent state. Because of this turbulence, the temperatures throughout the vessel are essentially identical. For example, in the regenerator of a typical large commercial unit, there will be a heat liberation of 120 MM BTU per hour. With this high degree of heat liberation, the maximum difference found at different points of the vessel has been less than 5 degrees and this difference probably reflects inaccuracies of temperature measurement rather than any real difference in temperature.

"The presence of the catalyst or inert powder gives the mixture in the vessel heat capacity, thus guarding against rapid temperature fluctuations. Heat can be removed or added to the system by circulation of catalyst through heat exchangers as are used on the regenerator in the diagram shown of the catalytic cracking plant. (*See Fig.* 1). This use of the fluid catalyst principle can be applied whether or not the catalyst needs revivification and also where no catalytic effect is desired. One application would be for controlling the reaction tempera-

°°°"War Developments of the Petroleum Industry", by E. V. Murphree, Standard Oil Development Co., New York.

TABLE 4—Motor Gasoline Yields by Fluid Catalytic Cracking, from Four Different Gas Oil Feed Stocks.

Feed Stock Feed Properties	East Texas Wide Cut	West Texas Wide Cut	West Texas Heavy	Coastal Wide Cut
Gravity, °API	31.7	27.3	22.3	22.1
Aniline Point, °F.	180	169	171	180
ASTM—50%, °F.	680	710	825	781
Sulfur, Wt. %	0.48	1.80	2.49	0.63
Product Yields				
Motor Gasoline (10 Lbs. RVP, 400° E.P.), Vol. %	45.0	43.2	46.0	46.2
Cracked Gas oil, Vol. %	51.2	51.2	51.2	51.2
Excess Butane, Vol. %	4.3	3.0	2.0	4.0
Dry Gas, Wt. %	4.3	6.3	5.6	5.4
Carbon Deposit, Wt. %	3.1	4.1	3.4	2.6

TABLE 5—Characteristics of Motor Gasolines Produced by Fluid Catalytic Cracking from Four Gas Oil Feed Stocks.

Feed Stock	East Texas Wide Cut	West Texas Wide Cut	West Texas Heavy	Coastal Wide Cut
°API Gravity	60.5	58.2	58.2	57.0
RVP, Lbs./Sq. In.	10.0	10.0	10.0	10.0
ASTM Distillation				
% D + L @ 158°F.	25.5	18.5	18.5	23.0
% D + L @ 212°F.	47.0	42.0	38.0	43.5
F.B.P.	406	400	401	406
Recovery, %	97.5	97.5	97.5	97.0
Aniline Point, °F.	85	76	82	71
Acid Heat, °F.	159	162	186	180
Breakdown, Hrs.	9	14.5	13	10
Octane No.				
CFR-R ('39) Clear	92.0	91.9	91.3	94.3
CFR-R ('39) + 1.5cc TEL	97.0	95.9	95.3	98.1
Cracked Gas Oil				
°API Gravity	30.0	21.7	22.7	22.0
ASTM—50%, °F.	572	605	605	563
Aniline Point, °F.	144	129	124	96

ture in the oxidation of aromatic compounds and particularly for the production of phthalic-anhydride from naphthalene. It is believed that the fluid catalyst principle may have application in metallurgical processes for reduction of ores and other operations. The principle would appear to have application to all types of reactions involving temperature control of gases, vapors or solids."

Controlling Interests

Investigations of applications of this principle of circulation of a solid in a fluid mass are already being carried on but no information can be given out at present. The application of the Fluid Catalyst process to petroleum refining was developed principally by Standard Oil Development Co., with the following companies also contributing: Anglo Iranian Oil Co., M. W. Kellogg Co., Shell Oil Co., Inc., Standard Oil Co. (Indiana), The Texas Co. and Universal Oil Products Co. For the production of aviation gasoline components in the wartime program, the process has been made available by the above interests to refiners generally.

Under a directive from the Petroleum Administrator for War calling on the original participants in catalytic cracking process developments to pool their information and cooperate to serve the war effort to the best advantage, these companies have prepared a basis for licensing the Fluid Catalyst process. This basis has been submitted to the PAW. In the meantime, the various licensors are proceeding without formal licensing agreements, the present understanding with the licensee being that a mutually suitable agreement will be entered into when the matter is clarified by the government authorities.

Fluid catalytic cracking unit of Standard Oil Co. of Louisiana at Baton Rouge, under construction. The steel framework is primarily for support of the reactor, regenerators, cyclone separators and connecting piping. To the right of the structure is the Cottrell precipitator, the small vertical stack being the final flue gas exit. The structure to the right is the catalyst storage system and a catalyst car is shown spotted in place. At the left, behind the heating furnace stack, may be seen a portion of the fractionation equipment

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Iso-Butane Yield per Pass 50% ~~35%~~

Foster Wheeler is now constructing Liquid Phase Isomerization plants for the production of iso-butane and other iso-compounds, and has plans under way for revamping earlier vapor phase units for liquid phase operation.

This new process requires less critical materials, lowers capital investment and reduces operating costs as compared to other processes previously available. Product is more uniform in quality.

Additional information will be furnished on request.

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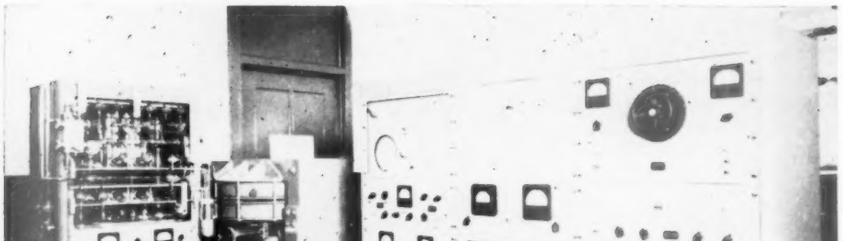


'Mass Spectrometry'

New Quantitative Method for Determining Light Hydrocarbons in Process Control

THE production of high octane gasoline components by various catalytic chemical processes, and of butadiene for synthetic rubber manufacture, has emphasized the growing need among refiners for an analytical tool which will give fast, accurate information on the components of raw feed stocks. Design calculations for new plants or units also are dependent on these data, as well as the rapid stabilization of a unit coming on-stream.

Formerly, low-temperature fractional analysis, charcoal adsorption test and various chemical analyses gave sufficient information. But with today's processes and those of tomorrow, it is necessary to know how much and how many isomers of C_3, C_4, C_5, C_6, C_7 and C_8 hydrocarbons are present. Moreover, it is necessary to know whether these compounds are paraffinic, olefinic, or cyclical. With conventional analytical methods it is exceedingly difficult, if not impossible, to determine individual components in a mixture of more than a few isomers of C_6, C_7 and C_8 hydrocarbons. It is believed the mass spectrometer provides a means for rapid and accurate analysis of the components of hydrocarbon mixtures.

For many years the mass spectrometer had been used only as a tool in physical research on atomic and molecular structure. Then the research department of Atlantic Refining Co., facing difficulties in analysis of a cracked hydrocarbon gas, hit upon the mass spectrometer as a satisfactory analytical tool.

Spectrometer 'Sorts' Molecules

A mass spectrometer is an instrument for sorting molecules, depending on the structure of the molecule as well as the type of atoms it contains for the separation. Aston[1] was one of the first physicists to develop this use, while the form of the instrument has been gradually changed and improved through the years.

It is well known that an electric current consists of an electric charge or charges in motion. It is as well known that an electric current is surrounded by a self-created magnetic field and that the path of the current will be altered if its magnetic field is acted upon by another magnetic field. Therefore, if the molecules of a gas are ionized—electrically charged with, for example, a positive charge—and these ions are set in motion by the attraction of an oppositely charged negative body, then these charged particles constitute an electric current. If these positive ions are made to travel through a magnetic field of uniform strength, then the particles will be deflected an amount depending on their velocity and charge. If the several particles each have more than one charge, or differ in mass, then the velocity imparted by an oppositely charged body will be a function of total charge and mass.

The reason why ions of different masses are deflected differing amounts by a uniform magnetic field is this: Assume each particle has one positive charge. Each, then, is attracted an identical amount by the same negatively-charged body, but since the masses are not identical, the velocity each particle will acquire in unit time will be proportional to its respective mass. Now, the strength of an electric current is proportional to the charge *and* the velocity; therefore, the magnetic field surrounding each charged particle also will be proportional to velocity only since unit charge was assumed. Thus, the stronger the current, the more it will be deflected by the uniform magnetic field. Hence, light ions are deflected more than heavier ions, because they are moving with greater velocity regardless of charge. Control of the deflection lies in the velocity imparted to each by the charge on the original negatively-charged body. In a nutshell, the mass spectrometer spreads the ions out in a series of "bands", the "bands" beginning in order of relative ionic mass.

How It Works

In one of its forms, the Dempster or 180° type of mass spectrometer consists of 4 parts: the gas inlet system, the ionization chamber, the semicircular analyzer tube, and the collecting and recording mechanism. Fig. 1 is a diagrammatic sketch of the instrument, a description of which follows:

In the mass spectrometer as developed for hydrocarbon gas analysis, the sample is admitted to the ionization chamber "a" where it is given a positive charge by electron bombardment. (In actual practice, this bombardment

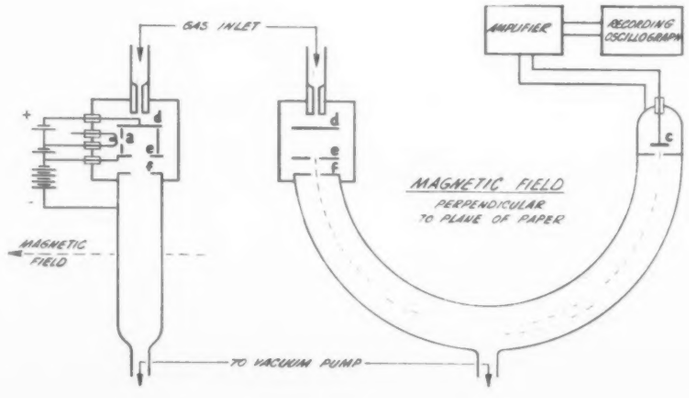


Fig. 1—Schematic diagram of a mass spectrometer

[1]Getman, F., and Daniels, F. *Outlines of Theoretical Chemistry*. J. Wiley & Sons, Inc., 5th Ed. 1931, p. 563-66.

is of such intensity that the molecules are broken into charged fragments, thereby permitting substances of identical molecular weight but of different structure—isomers—to be distinguished from each other.) These positively charged particles then are pulled out of the ionization chamber by means of a negatively charged electric field existing between electrodes "d", "e" and "f", entering the analyzer tube at a high velocity. In the analyzer tube the particles are subjected to a uniform magnetic field which, acting perpendicular to the radius of the curved tube, causes them to move in a circular path. At the end of the tube is a collector plate "c" which, in effect, counts the particles as they strike by means of the amplifying and recording equipment.

It will be noted (Fig. 1) that the collector plate is stationary. In order that each component of the "spectrum" shall register on the plate, the negative charge at electrodes "d", "e" and "f" is varied to control the velocity of the particles. This has the net effect of "moving" the "spectrum" across the plate in such a manner that each component registers successively through an amplifier and recording oscillograph.

Military secrecy forbids details concerning the actual electrical hookup, the gas inlet system and the manner of translating the oscillograph record. Fig. 2 is a photograph of a commercial spectrometer, designed for and capable of making quantitative gas and liquid analyses. In the center background is the electromagnet which produces the uniform magnetic field in which the mass spectrometer proper is placed. Immediately to the left of this magnet is the sample inlet system and evacuation apparatus (pressures in the spectrometer proper are from 35 to 40 mμ). In the right foreground is the operator's table and rack which houses the automatic recording apparatus and power packs. These power packs supply closely regulated voltages to the spectrometer and magnet. This instrument now is in use by Atlantic Refining Co. at its Philadelphia laboratories. It was built by the Consolidated Engineering Corp., Pasadena, Calif.

In order to increase the instrument's reliability and protect it as well as to simplify operation, a number of automatic protective features are incorporated. These features permit use of relatively unskilled operators in taking data. In this connection, it is said to be possible for a person who has had algebra to learn the method of calculation for most analyses within 2 weeks. The same time is required to train an operator who has had good grounding in electronics to make necessary adjustments of the instrument as well as operate it and make calculations.

How Data are Assembled

In order that quantitative results fraction in the mixture and adding a sample must be truly a summation of the spectra of every individual component. There must be no "blending" such as is encountered in fractional distillation, or "masking" and "interference" as in a chemical determination. Fig. 3 shows spectra of pure ethane, propane, n-butane, isobutane and n-pentane in which abscissae are mass and ordinates are amounts of each mass. Fig. 4 shows the spectrum of a typical wet gas mixture for comparison.

It will readily be seen that if "x" components are present, the composite mixture spectrum is identical to that obtained by multiplying each peak in the spectrum of each component by its mol fraction in the mixture and adding the resultant products for each peak. Note that in the cases if iso-and normal-butane, for example, peaks showing fragments of the same mass are present, but the proportions of identical mass fragments differ sufficiently to make analysis possible. It is this which permits identification of isomers of the same hydrocarbons.

Question of "what about correction for isotopes of the various elements?" probably has been raised in the reader's mind. The answer is: "Correction for isotopes is definitely necessary in the use of the mass spectrometer." The ratio of heavy hydrogen to light hydrogen, heavy carbon to light carbon, and so on, occurs the same everywhere in nature. Correction therefore requires knowledge of the ratio of the heavy atoms to the light ones, and physicists have long since adequately determined this information.

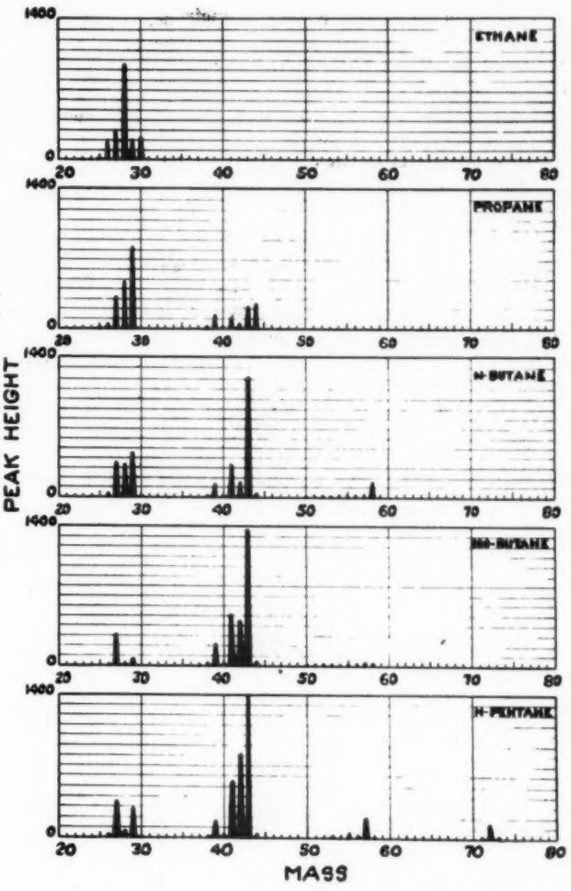


Fig. 2—Sample "mass spectra" of 5 pure hydrocarbons

Analytical Computations

When a sample of methane or ethane is analyzed, it is never broken into fragments; lighter hydrocarbons generally are. All through the spectra of pure compounds shown here (Fig. 3), a number of peaks will be found with a relatively wide gap between the various groups of peaks. In spectra of mixtures therefore, it is possible in many cases to solve for one component at a time.

A point of special interest here is that all peaks recorded are generally not needed for an analysis. The peaks which are not needed for calculation of the mixture are used as a check on the accuracy of the analysis, being employed in such a way as to show instrument and calculation errors. This is a very valuable feature and many times eliminates necessity of running a check determination.

Isomeric components generally require solution of simultaneous equations, and where there are a number of isomers present, it is necessary to solve possibly 5 or 6 simultaneous equations which means use of determinants or some system of matrix algebra. For this reason calibration is not yet complete for all known hydrocarbons, straight-chain and cyclical, between limits of C_2 through C_8. At the present time, arrangements are reported under way for calibration up through the C_9 hydrocarbons.

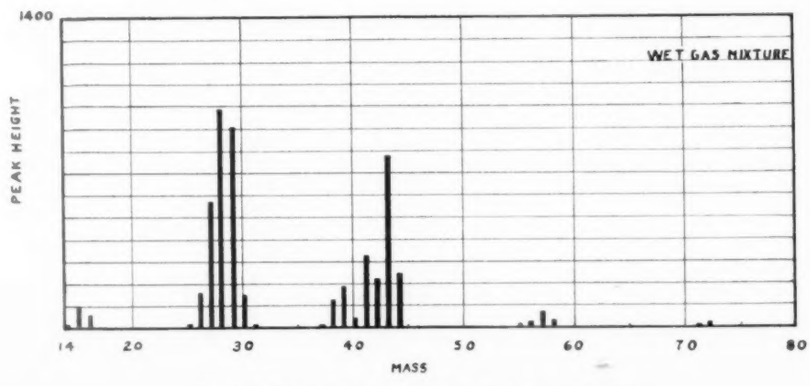


Fig. 3—"Mass spectrum" of a wet gas mixture

Analysis of Light Hydrocarbons By Mass Spectrometer

A 10-component mixture containing methane, ethane, ethylene, propane, propylene, n-butane, i-butane, i-butylene, butene-1 and butene-2 requires less effort in interpretation than would a mixture of 5 isomeric C_6 hydrocarbons. This difference in case of computation lies in the fact that in the first mixture many of the components can be determined separately; whereas in the latter, solution of 5 simultaneous equations is necessary. In general, an experienced operator and computer who makes analyses of all types averages about 2 hours per sample—including running the instrument, check calibration and computation. Many samples containing from C_1 through C_4 can be analyzed in a half hour. Butadiene is a particularly easy component to distinguish and can be picked out qualitatively almost at a glance. If samples of approximately identical composition are run daily, butadiene can be determined in about 15 minutes, and a whole analysis completed in 1½ hours.

The Instrument in Use

The actual operation of the instrument for research or process control in natural gasoline plants or refineries is exceedingly simple, in that there are only 3 operations: (1) Selection of the sample, which should be taken in any quantity which is easy and convenient to handle. Cylinders of 100 cc. capacity are satisfactory, but the instrument will require only 0.1 cc. gas at atmospheric pressure, so its value in experimental work is apparent. The others are routine operations, involving in succession, (2) the manipulation of the proper stopcocks to introduce a sample into the ionization chamber and (3) manipulating the proper switches to start automatic recording of data.

The gas pressure in the instrument should not exceed 30 to 40 mμ; otherwise the mean free path of the ions will be less than the length of the analyzer tube and thus fail ever to reach the collector plate. If a sample is taken at high pressure it must be suitably reduced to this pressure range before analysis. If a liquid sample is used, it must be heated to a temperature which will render it in gas phase at this pressure while taking precautions to assure maintenance of homogeneity. Pressure of unknown sample in the instrument must be the same as that when calibrating samples are run. Calibration may be either before or after running the unknown, and should form a part of each analysis if extreme accuracy is sought.

Analytical Accuracy

Tables 1, 2, 3 and 4 show what can be done with the mass spectrometer. To date, more than 1000 analyses of hydrocarbon gases have been made and the instrument has been run continuously over a 4-month period to test reliability of operation. During the continuous operation, 15 to 20 runs were made in every 8-hour daily shift, but voltages were left on at all times except Sundays to simulate 24 hours per day operation.

Table 1 shows an analysis of a synthetic 10-component sample made up of paraffins and olefins having 1 to 4 carbon atoms each. The sample was made by carefully mixing pure components, the amount of each being determined by a manometer (Manom.) and recorded in the first column. Analysis by mass spectrometer (M. S.) is shown in the second column while the third column shows the difference (Diff.). This analysis was selected to indicate average accuracy on this type mixture. Generally, total butenes and separate paraffins are determined to same degree of accuracy, but separation of butenes -1 and -2 is less accurate due to similarity of butenes' patterns. Average errors in determining butenes are approximately 3 times those in determining separate paraffins. If small amounts of C_5 (in neighborhood of 1%, for example) are present in such a mixture, analysis time is increased about 15 minutes and probable error in separating butenes is 0.5% greater. If larger amounts of C_5 are present, total butenes can be easily determined, but the accuracy with which butenes can be separated must await additional data.

Table 2 shows 3 synthetic samples containing varying amounts of butadiene. It will be noted that small or large amounts of butadiene are detected with accuracy of 0.3%, but when the partial concentration is about 50%, accuracy of determination falls to 0.7%. Accuracy in determining other components is only slightly affected by butadiene. In the third analysis, a relatively large error in determination of butenes -1 and -2 is notable; it is shown so that the poorest as well as the typically good results will be represented.

Table 3 shows analysis of a non-synthetic sample containing C_5 and C_6 paraffins, cyclics and aromatics compared with results by fractionation in a 100-plate column and refractive index determinations on the fractions separated in the column. Time required for the mass spectrometer is materially shorter than required for fractionation.

Table 4 shows an analysis for benzene, toluene and xylene in a synthetic gasoline of indicated composition. This is illustrative of the possibility of determining accurately only 1 or 2 components of a complicated mixture without the necessity of considering the other components.

Table 1

C_1—C_4 Paraffin, Olefin Synthetic (Mol %)

	Manom.	M.S.	Diff.
Methane	11.3	10.9	—0.4
Ethylene	1.5	1.7	+0.2
Ethane	22.1	21.4	—0.7
Propene	11.9	11.8	—0.1
Propane	31.1	31.0	—0.1
Iso-butane	5.0	5.0	0.0
Iso-butene	4.4	4.7	+0.3
Butene-1	5.0	6.2	+1.2
Butene-2	0.7	0	—0.7
N-butane	7.0	7.3	+0.3

	Complete Analysis	Normal, Isobutane, Total Butenes
Man Hours	3¼	¾
Elapsed Time	2 Hrs. 50 Mins.	¾

Table 2

C_4 Paraffin, Olefin Diolefin Synthetic (Mol %)

	1			2			3		
	Manom.	M.S.	Diff.	Manom.	M.S.	Diff.	Manom.	M.S.	Diff.
Propene	0.9	0.4	—0.5	0	0	0	0	0	0
Butadiene	66.6	67.2	+0.6	92.6	92.5	—0.1	3.8	3.8	0
Isobutane	0	0.6	+0.6	0	0	0	0	0	0
Isobutene	0.9	1.0	+0.1	0	+0.2	+0.2	30.4	28.9	—1.5
Butene-1	7.1	8.1	+1.0	1.9	2.0	+0.1	31.4	29.2	—2.2
Butene-2	6.9	5.5	—1.4	5.5	5.3	—0.2	34.4	38.1	+3.7
n-Butane	17.6	17.2	—0.4	0	0	0	0	0	0

	Complete Analysis	Butadiene Only
Man hours	3¼	35 Minutes
Elapsed Time	2 Hrs. 50 Mins.	35 Minutes

Table 3

C_5 and C_6 Paraffins, Cyclics and Aromatics (Mol %)

Hydrocarbon	Fractionation (100 Plate Column)	Ultra-Violet Absorption	Mass Spectrometer	Difference
Pentanes	3.8	..	3.7	—0.1
2-2 Dimethylbutane	14.0	..	15.0	+1.0
Cyclopentane	1.6	..	2.0	+0.4
2-3 Dimethylbutane	9.4	..	7.7	—1.7
2-Methylpentane	33.0	..	32.2	—0.8
3-Methylpentane	13.9	..	14.6	+0.7
n-Hexane	12.8	..	13.5	+0.7
Methylcyclopentane	8.7	..	9.3	+0.6
Benzene	2.9	2.0	2.1	—0.8+0.1

10 Man Hours
9 Hours Elapsed Time

Table 4

Gasoline+Aromatics, Synthetic (Mol %)

		1			2	
	Synthetic	M.S.	Diff.	Synthetic	M.S.	Diff.
Non-aromatics	49.1	49.1	0	52.9	55.0	+2.1
Benzene	12.7	12.5	—0.2	5.7	5.7	0
Toluene	37.9	38.4	+0.5	21.0	21.8	+0.8
Xylene	...	...	...	20.3	17.5	—2.8

Non-aromatics in above mixtures

n-Hexane	n-Heptane
2-Methylpentane	Methylcyclohexane
2, 3-Dimethylbutane	"Isooctane"
Methylcyclopentane	"Isooctene"
Cyclohexane	

2¾ Man Hours
2¾ Hours Elapsed Time

Application in Refinery Control; Process Feed Stocks and Products

The processes used in refineries and natural gasoline plants in the conversion of naturally-occurring hydrocarbons to motor and aviation fuels all require analytical methods for proper control. Moreover, accurate analysis of the proposed feed stock is necessary in determination of the proper factors for design computations; these data should be at hand long before construction of the unit ever starts. Admittedly, many efficient plants have been constructed on experience alone, but today's processes call for application of the highest type of engineering practice in both design and operation.

Processes Described

Below is a brief discussion of processes and types of feed stocks employed, covering the most important processes now being used, taken from a recent report by Roberts, Washburn and Leum[2]. It should be remembered that the reactions discussed below are much more complicated in practice than the reactions given would indicate. This is because of the side reactions and molecular rearrangements which inevitably occur to some extent and also because the feed stocks used in practice are seldom a single, pure hydrocarbon.

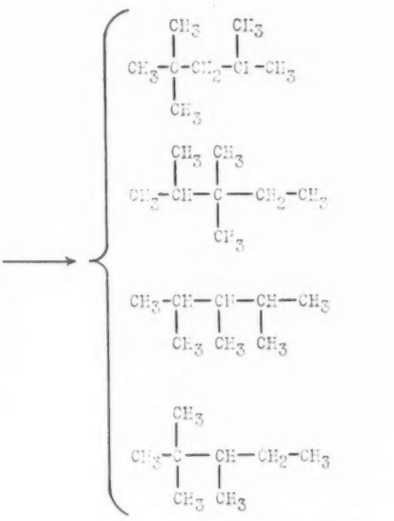
Acid Alkylation

"As an example of the control of composition and of the complexity of the feed stock, the case of acid alkylation may be considered. By fractionation a stream of hydrocarbons containing mostly 4 carbon atom molecules could be prepared. However, the olefin content of the stream must be balanced by a like amount of isobutane. In some cases this may be accomplished by careful control of the fractionating column but in other cases where the olefin exceeds the isobutane content, the stream may be first passed through a polymerization unit to remove the excess olefin. The stream thus prepared may have an analysis as follows:

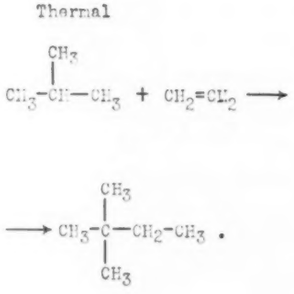
C_3's—3	Mol %
n-Butylene—15	" "
iso-Butane—15	" "
n-Butane—64	" "
C_5's— 3	" "

The reaction between isobutane and butylene requires that one molecule of each of these hydrocarbons unite with one another. However, if the material in contact with the acid catalyst contains a 1:1 ratio of these hydrocarbons, the amount of polymerization among butylene molecules will be excessive; therefore, the ratio of isobutane to butylene is greatly increased. In order to do this, a hydrocarbon stream which is essentially isobutane is added to the above mixture so as to obtain a ratio of about 5:1 for isobutane and butylene.

Catalytic



Thermal



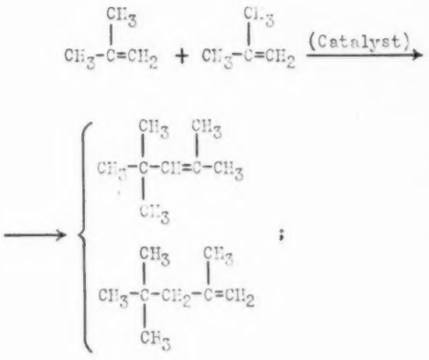
"The isobutane not used in the reaction is fractionated from the product and recycled to make up the desired 5:1 ratio of isobutane and olefin charged to the reaction chamber. It is readily apparent that careful control of fractionation by frequent analysis is required in order that constancy of product from the alkylation process is maintained.

"The stream of isobutane may come from recycling, from a fractionating tower operating on a mixture of plant gases or from a natural gasoline plant which made this product by fractionation. Regardless of where it originates, control of the fractionation requires frequent analysis in order that constancy of product can be maintained even though the composition of the charge to the tower varies.

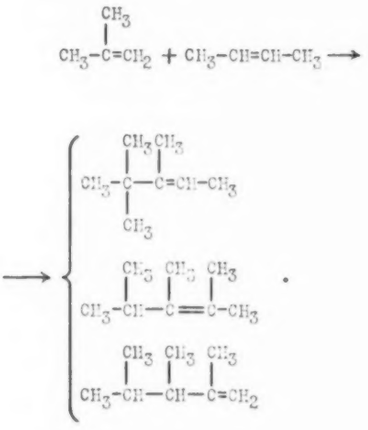
Polymerization

"Both thermal and catalytic polymerization are employed in motor fuel and aviation gasoline production. The feed stock usually consists of hydrocarbons having 3 or 4 carbon atoms per molecule. In selective operation 2 or more molecules of the same unsaturated hydrocarbon combine to give a larger molecule. In non-selective operations 2 or more molecules of unlike unsaturated hydrocarbons unite to give a molecule of higher molecular weight. For example:

Selective—product is a multiple of original hydrocarbon.



Non-selective (copolymerization) — product very complex.



In thermal polymerization some of the saturates are converted into unsaturates and therefore both the saturated and unsaturated hydrocarbons enter the reaction, whereas in the catalytic process only the unsaturates present in the feed stock react. In both cases, unsaturated hydrocarbons are formed which require the addition of hydrogen to produce a saturated motor fuel material. In catalytic polymerization for aviation gasoline it is desirable that all the isobutylene react with just enough of the normal butylenes to obtain the maximum yield of product without materially affecting the anti-knock value. A typical feed stock for catalytic operation is:

C_3's— 3	Mol %
Isobutylene—14	" "
n-Butylene—29	" "
n-Butane—42	" "
Isobutane—10	" "
C_5's— 2	" "

The catalytic polymerization reaction on such a feed stock can be controlled to give a satisfactory aviation gasoline and also produce an effluent stream of composition satisfactory for charge to the alkylation unit.

[2]"The Mass Spectrometer and Its Application to Petroleum Refining", presented before American Chemical Society, Petroleum Division, Detroit Meeting, April 12-16, 1943.

Isomerization

"The term (isomerization) as applied to the petroleum industry is limited to the conversion of straight chain hydrocarbons to branched chain structures. The chloride of aluminum is used as a catalyst in the commercial process but other halides of this metal are also effective. The process is applied to the isomerization of n-butane to isobutane for the preparation of alkylation feed stock.

$$CH_3-CH_2-CH_2-CH_3 \xrightarrow{(Catalyst)}$$

$$\longrightarrow CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3 .$$

This isomerization process is usually so coordinated with the alkylation process that the feed stock for the former is a n-butane stream from the fractionation of the unreacted C_4's of the latter. Such a stream may have the following composition:

Olefins— 0 Mol %
Iso-Butane— 5 " "
n-Butane—94 " "
C_5's— 1 " "

Aromatization

"This process (aromatization) takes place either thermally or catalytically but the yields obtained by thermal means are so low that it is not used commercially. The reaction is that of the conversion of saturated hydrocarbons to those having a benzene ring. Benzene and toluene are made from hexane and heptane respectively. Hydrogen is evolved from the reaction in considerable quantities.

$$CH_3-CH_2-CH_2-CH_2-CH_2-CH_3 \xrightarrow{(Catalyst)}$$

$$\longrightarrow \begin{array}{c} H \\ C \\ HC \quad CH \\ \| \quad \| \\ HC \quad CH \\ C \\ H \end{array} + 4H_2 .$$

"In converting straight chain paraffins, such as normal hexane and heptane, into aromatics, it is essential that the feed stock contain these hydrocarbons in fairly high concentrations. Since no such feed stocks are available, aromatization is effected by catalytically dehydrogenating selected stocks which contain naphthenic hydrocarbons.

Hydrogenation

"The chief use of this process (hydrogenation) is in saturating the olefinic hydrocarbons formed in the polymerization process. This is a non-destructive form of hydrogenation. Catalysts which have been used are nickel, platinum, the oxides of molybdenum, chromium, nickel, cobalt, and some of the other metals. Molybdenum sulfide has also been used. The boiling point of the hydrogenated material is essentially the same as the feed stock.

"When high temperatures are employed, cracking takes place which is followed by hydrogenation, taking place at the place of scission of the carbon bonds. This type of hydrogenation is often referred to as destructive hydrogenation. The composition of the feed stock is very heterogenous and a catalyst is employed.

"Examples of the above are:

Non-destructive Hydrogenation

$$CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}}-CH=\underset{\displaystyle CH_3}{\underset{|}{C}}-CH_3 + H_2 \xrightarrow{(Catalyst)}$$

$$\longrightarrow CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-\underset{\displaystyle CH_3}{\underset{|}{C}}-CH_3 .$$

Destructive Hydrogenation

$$CH_3-CH_2-CH_2-CH_2-CH_2-CH_3 + H_2 \xrightarrow{(Catalyst)}$$

$$\longrightarrow CH_3-CH_2-CH_2-CH_3 + CH_3-CH_3 .$$

"As advances in the art of motor fuel production are made, the refiner must know whether or not he has the available feed stock material in order to utilize any given process. If this material is not available, he must either buy or make it if he intends to use the process. In order that he be in a position to determine the applicability of a process to his refinery, he should at frequent intervals determine his avails of the various hydrocarbons. Changing composition of purchased materials such as crude oil and natural gasoline, changed operating conditions of plant units, or the introduction of new processes continually change his avails of the various hydrocarbons and as a consequence material balances should be made frequently.

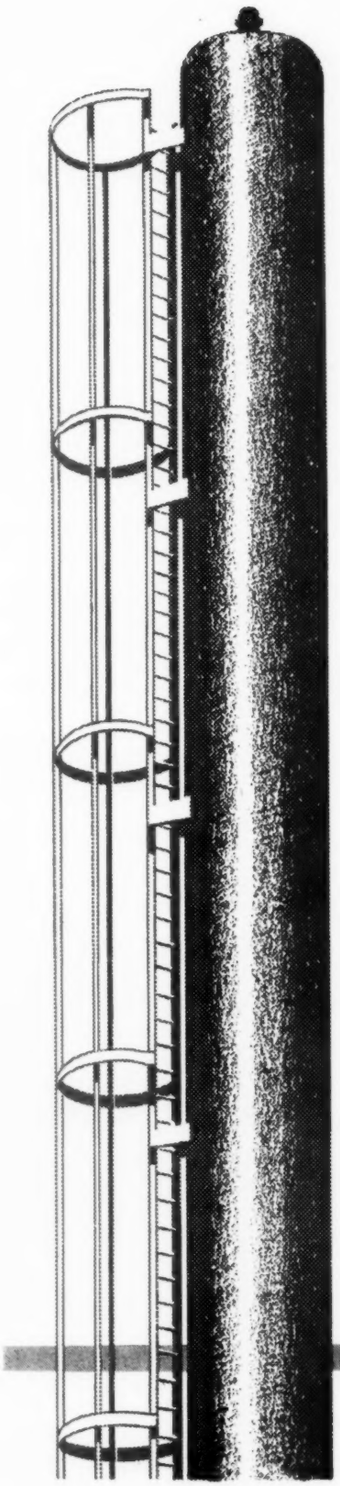
"Comparison of the analyses of the hydrocarbon mixtures presented (above) with the typical feed stocks for the various processes illustrates the use of the mass spectrometer in solving the refiner's problems which depend upon analytical control. The limits of capability of the instrument have not yet been determined but it has already extended the range of ordinary methods. It is anticipated that in the near future this instrument, together with supplemental methods, will expand the list of hydrocarbons for which quantitative analyses can be obtained so as to include practically all the components which boil in the motor fuel range."

Cost Not Excessive

The cost of the instrument, $19,500, is not considered excessive because of its value as an analytical tool. Indeed, it has been reported less expensive, in the long run, than conventional fractional analysis, because of the savings in man-hours and operating supplies. One user has claimed the instrument will pay for itself in 500 analyses with these savings alone.

Alkylation plant for manufacture of aviation gasoline. (Photo from Lummus Co.)

WHY IT'S MORE PROFITABLE TO BUY ON THE Chemical Grade* BASIS



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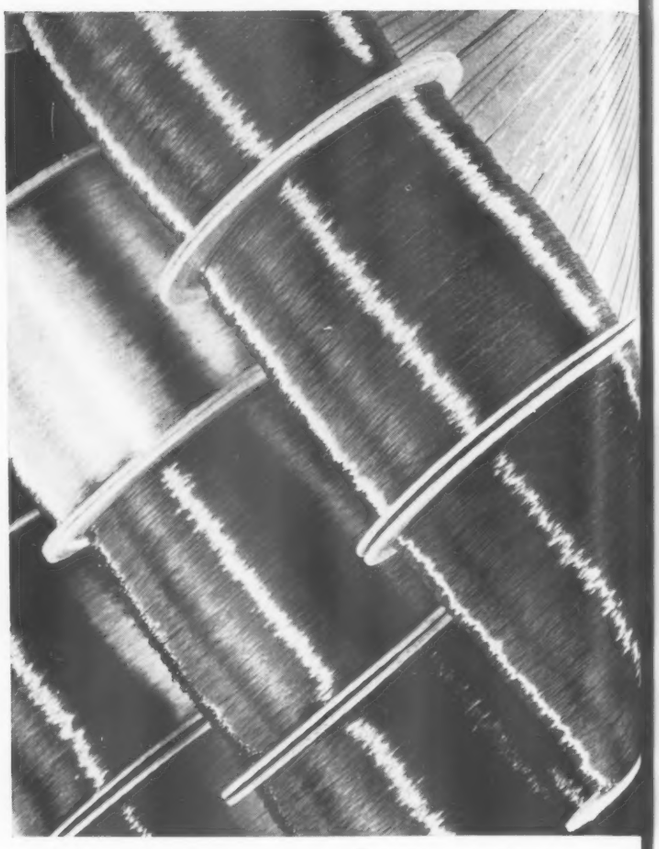
ABC of CHEMICAL DERIVATIVES FROM PETROLEUM

VII. Basic Economics of Petroleum Chemicals Field

By R. L. WAKEMAN[1] and B. H. WEIL[2]



Scintillating, jewel-like synthetic fibers from petroleum chemicals (cellulose acetate-butyrate) are finding increasing usefulness in the textile industry. They illustrate but one field served by new petroleum chemical products. Manufacture of base materials for a wide variety of these products will be an important postwar development of the petroleum industry

WHO would have dreamed at the close of World War I that the next 25 years would bring such profoundly new changes in the petroleum industry? Who could have foreseen the advent of close fractionation, reforming, polymerization, hydrogenation, hydroforming, polyforming, catalytic cracking, alkylation, and isomerization? Who could have foretold that the next World War would witness the petroleum industry supplying synthetic rubbers, plastics, synthetic fuels and other chemical materials along with its historic bulk products of gasoline, lubricants, and fuel oils?

A few visionaries there were, but they were scorned. Indeed, despite the advent of many of its newer processes, only recently has the petroleum industry developed confidence in the future of the new fields of enterprise into which it has entered almost unwittingly.

Petroleum economics, even in normal times, is a complex labyrinth into which the unwary should not venture. There the criss-crossed paths of gasolines, with their bypaths of octane-number requirements, treating costs, and lead susceptibilities, of lubricants, with their side-lanes of pour point, stability, detergency, and other competitive angles; of fuel oils, with their alleyways of yields and market demands; and of asphalts and coke form a tortuous system through which only the wise company may select its way with profit. Superpose upon this maze the economic complexities of the chemical industry, becloud both systems with the mists of war, shower them with a continual rain of war-catalyzed technical progress; then let the cartographer and pilot beware!

In the petroleum world of today, it is nevertheless vital that each company prepare itself for its journey into the future. As the path it must follow is neither smooth nor straight nor with an end in sight, every forethoughtful petroleum company must gird itself for this journey with the best scientific maps of the past, with knowledge of what shifts the tempests of technical change may have made therein, and each must take with it on the journey those men who can build new roads where the old ones end, who can erect new bridges where those of the past have fallen.

It seems inevitable that in the future each oil company, large or small, must decide whether or not to enter or to remain permanently in the field of petroleum chemicals. The petroleum industry's war effort has caused most companies to play minor or major roles in wartime chemical projects—as suppliers of base stocks and fractions, extractors of aromatics, producers of intermediate materials, or manufacturers of semi-finished chemicals such as butadiene, styrene, isobutylene, toluene, and cumene. Those companies engaged in the latter phases of endeavor have invested huge sums in plant equipment or are operating giant government-owned units. They either possess or have available plant facilities which serve to keep them abreast of the times and enable them to keep a foot in the door of the future. These companies, certainly, are not closing their eyes to what is before them. It is vital for other companies, therefore, to keep abreast of what is being done so that they, too, may decide what part they are to play when construction materials again become freely available—how best they can overtake the lead of those concerns already in the field.

Factors Influencing a Decision

In general, a petroleum company may advisedly contemplate entering the field of chemical derivatives where one or more of the following situations prevail:

(1) It has available a large volume of a certain raw material required for the manufacture of a chemical consumed in considerable quantities.

(2) It has at hand a unique raw material capable of serving in the production of a new and potentially important industrial chemical.

(3) It is wasting large volumes of a by-product, such as natural gas or refinery sludges, which might be converted economically to useful materials. The chemical utilization of wastes is an essential part of a national program of conservation.

(4) It is able to develop a strong patent position in the production of a chemical of present or potential large-volume demand.

(5) It can economically manufacture additives required to enhance the value of its own bulk products.

(6) It possesses sales and technical service staffs with well-established contacts with another industry which is a potential consumer of its chemical products.

Once it has been determined that at least one of these conditions prevails, other questions must be settled. How well adapted is existing equipment to the manufacture of

[1]Pittsburgh Equitable Meter Co.'s Industrial Fellowship, Mellon Institute, Pittsburgh.
[2]Chemistry Division, Gulf Research & Development Co., Pittsburgh.

chemical derivatives? To what extent should a plant undertake new construction? How far should a company go in converting its raw materials into finished chemical products? What idiosyncrasies of chemical economics need be considered? What form of company organization should be set up to manufacture and market chemical derivatives? How elaborate a research program should be established?

Information

In order to arrive at an evaluation of many of these problems, the first prerequisite is to define some organization or procedure to keep the company abreast of current developments, to enable it to discern the progress and trends with some degree of safety, if or when the opportunity may arise for entry into the field. If the company is small, this work might best be a cooperative function of its technologists and whatever library staff it possesses, or, if it has no library, it might be conducted either by hiring or training a specialist for the basic bibliochrestic work. If the company is large, however, if its present and future interests are likely to be diverse, and especially if it possesses a research division, technical information service should properly be related to research, as it there can be interpreted and coordinated with investigational projects, thus helping to avoid the pitfalls of patented processes and to facilitate the evolution of new ones, resulting in the saving of considerable sums of money by preventing duplication of work.

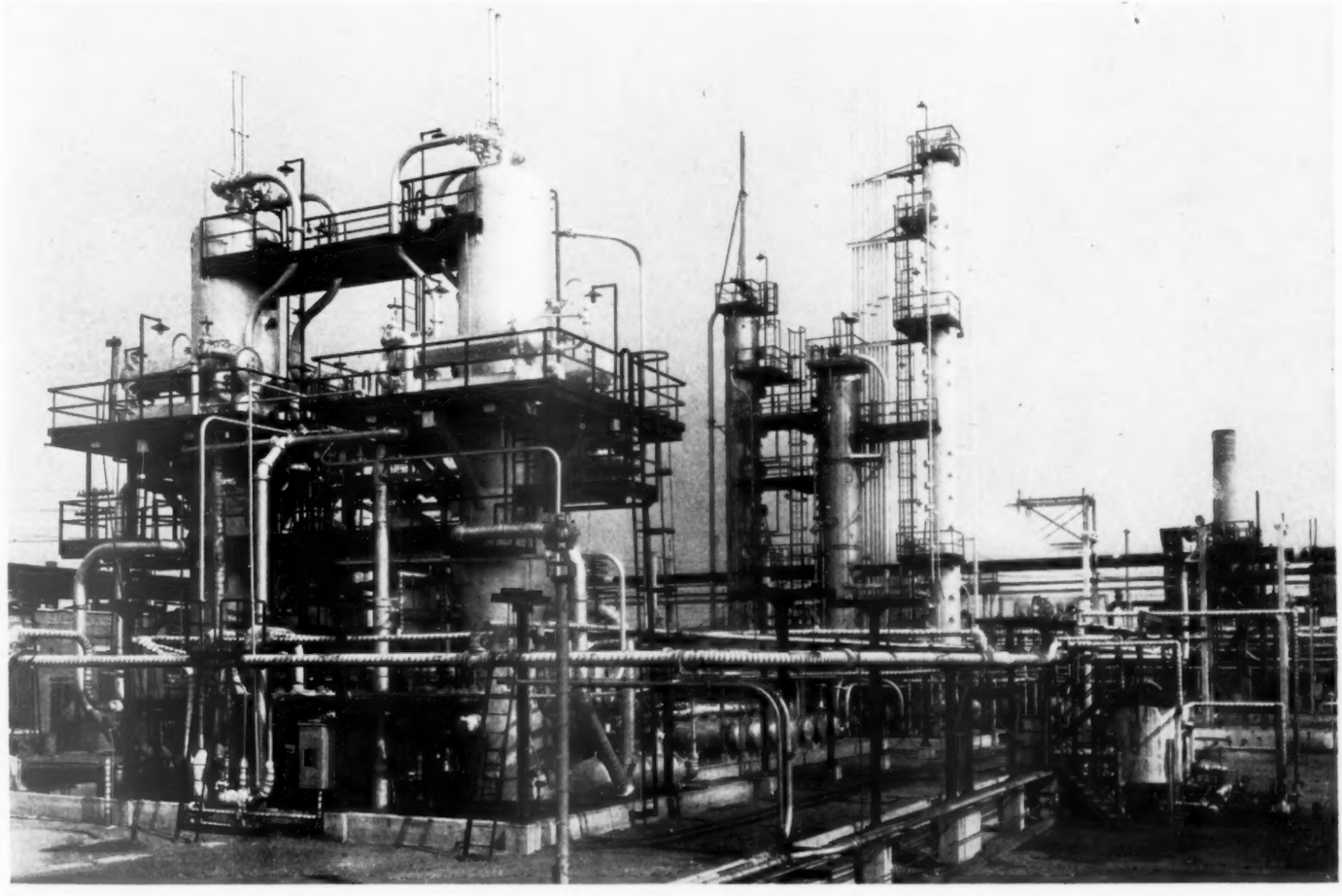
An information department should be thoroughly familiar with the basic raw materials of the petroleum industry now used in the manufacture of chemical derivatives such as those discussed in previous articles of this series. It should also be aware of current developments that may permit the conversion of raw materials into other hydrocarbons like acetylene which, in turn, may serve as a basis for still other chemicals not presently derived from petroleum. It should also possess the vision to see potentially valuable raw materials not now employed.

Relatively little, for example, has yet been done with the conversion of hydrocarbons above C_5 into useful chemicals. Nothing has been attempted in the way of converting petroleum hydrocarbons into acetylenes containing more than two carbon atoms—compounds which are extremely reactive and possess great potentialities as chemical intermediates. Still other sources of petroleum derivatives lie almost untouched.

Raw Materials

Next, each company must know its raw materials intimately, for it must be able to decide whether the gas stream from a natural gasoline plant or the effluent gases or liquid products of a refinery contain sufficient quantities of the hydrocarbons essential for the manufacture of chemical derivatives. Knowledge of quantity alone is not sufficient, either. Concentration of each particular hydrocarbon or fraction is also a prime factor. It will determine the amount of equipment required to separate the substance in the necessary degree of purity. The producer of most commercial chemicals in recent years has had to meet higher and higher standards of purity and uniformity. Especially is this a problem for manufacturers of chemicals from petroleum, where, for example, reaction of mixtures of olefinic materials have been known to yield complex products requiring entirely too much separation and purification, even where possible.

Modern petroleum technology demands close-cut-fractions — almost chemically-pure propane, propylene, butane, or butylenes, for example—and it requires the rigorous exclusion of sulfur compounds and other harmful impurities. Butadiene for synthetic rubber must be of exceptional purity. Certain products, on the other hand, do not need such careful purification. Mixtures of paraffinic hydrocarbons, for example, may serve as raw materials for the manufacture of chlorinated plasticizers, detergents, and pour-point depressants. Thus the prospective entrant into the field of petroleum chemicals must really



Plant for recovering liquefied refinery gases. Plants of this type annually recover thousands of barrels of liquefied products from refinery gases. Such products, used in peacetime as motor fuel blending stocks, now find extensive application as raw materials for synthetic rubbers and plastics and other important substances. (Photo from Esso Marketers)

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CLARK Steam-Driven "Angle", offered in 3, 4, 5, 6 and 8-cyl. models, ranging from 500 to 4,000 H.P.
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Clark engineers, in an intensive period of intimate contact with the compressor problems of the new industry, have gained knowledge and experience of priceless value to those who will engage in it. Call them into consultation.

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Dashboard of car, with panel, clock faces and radio dials of "Lucite" methacrylate plastic. Prior to the war plastics were associated in the public mind with spectacular novelty uses. The war, however, has proved their utility as engineering materials and wide expansion of the use of plastics will be one important peacetime development in this country. (Photo from du Pont Co.)

know his raw materials or he may encounter disaster almost before he begins. He must have researchfulness, constant science-mindedness, and managemental alertness.

Equipment Costs; Amortization

The problem of plant expense is indeed a weighty one. High equipment costs often deter companies from using processes otherwise promising. In this rapidly-changing technical world, obsolescence is a factor which overnight may change a profitable process into a liability. The most desirable process, therefore, all other factors being equal, is one which requires the least expenditure for equipment so that the time of amortization may be set at an arbitrarily short period without too great effect on unit costs. For this reason, efficient design and engineering are prerequisites for the success of any process, chemical or otherwise, and each company must consider carefully what equipment any process will require. For the duration, of course, only those plants whose products are needed urgently and whose construction requires a minimum of critical materials may be considered, but after the war engineering economics will have its say with a vengeance. The mores of wars generate sound planning and cautious management.

How Far Should Each Company Go?

The question naturally arises as to how far the individual company should go toward making finished chemical products. Should a refiner be content with merely liquefying his hydrocarbon products and shipping them all in one bundle? Should he fractionate his products, leaving final purification and chemical synthesis to the next company in line? Should he carry the process through the purification step? Should he actually synthesize chemicals and chemical intermediates? Finally, should he even go so far as to turn these chemical products into consumer goods?

Universal rules for solving such problems cannot be established. These questions relate to the aforementioned matters of foresight in market research, availability of sufficient raw materials and equipment, amortization costs for the equipment involved, the more-or-less intangible factors of know-how and general experience, patents, availability of capital, and the smoothness with which each or all stages of the process fit into the refinery pattern. If several steps are to be followed, if the company decides to produce finished chemicals or consumer products, then the factors of organization and marketing enter in, also. Several small manufacturers that began hydrocarbon product operations in 1916 are still prospering.

Chemical Economics

What about the economics of the product or products to be made? Suppose a casual market survey indicates that it might be profitable to produce one or several products from a common base. Suppose the company is most eager to diversify its position and decides that it definitely wants to produce a chemical derivative. Each likely product must then be appraised carefully from every viewpoint, and the producer must become aware of the differences between chemical and petroleum economics. He must learn that:

Bus tires like these, made from Buna-S type synthetic rubbers which use petroleum hydrocarbons as base materials, are now being subjected to the severe conditions of heavy duty commercial operations. It is reported that Buna-S tires for passenger cars are proving entirely satisfactory. (Photo from U. S. Rubber Co.)

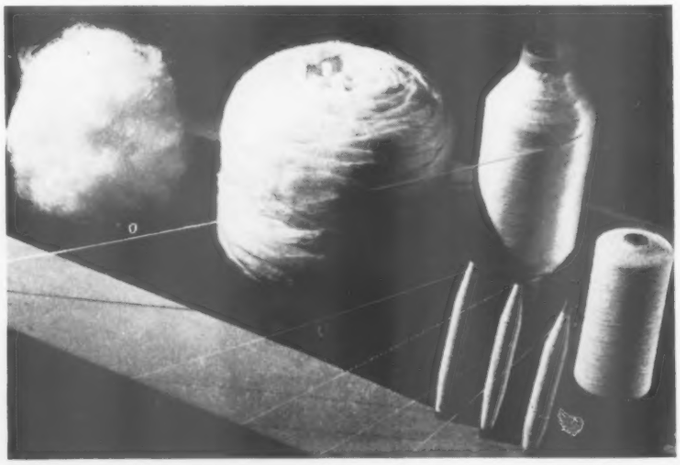
1—A synthetic, no matter how cheap, cannot displace a by-product, but can only supplement it. Glycerol, for example, is a by-product of soap manufacture, and cannot be dislodged by the synthetic material.

2—No matter how easy it may be to manufacture a hydrocarbon derivative, there can be no profit in it unless a market exists or can be developed. Tertiary butyl alcohol for example, was first produced some 15 years ago, but operations had to be discontinued because of lack of a market. Manufacture was resumed only after technologic advances created a demand for this chemical. In this connection, it should be noted that rarely has a new chemical been produced without ultimately arousing a demand therefor. The interim between its supply and demand, however, may be of such duration that only a financially strong company can afford to invest in the development of a substantial market. Certain resins, moreover, like those derived from methyl vinyl ketone or from sulfur dioxide and olefins, were developed on a semi-commercial scale several years ago, but are as yet unsuccessful. Creation of a market in these instances depends upon improvement of the physical and chemical properties of the products—a slow, costly, and as yet unachieved research project.

3—A small expanding market is more attractive than a large static one. The historical evolution of acetic anhydride is an excellent illustration of this fact.

4—The ideal products are those that have expanding markets and that are rapidly destroyed in use (petroleum's bulk products are of this type). There are very few hydrocarbon derivatives in this category at the moment.

5—The most profitable lines of research are those directed at low-cost manufacture of intermediates which are now expensive but are required for products of high quality. Certain highly attractive resins, for example, while made in large volume for military uses, are too expensive to find wide peacetime application in competition with phenolics.



Synthetic fibers developed from petroleum chemicals are revolutionizing the textile industry. Those shown here are made of cellulose acetate, a rayon which can be used in fiber form and as staple for use on spinning systems designed for cotton, silk, wool or worsted. (Photo from Tennessee Eastman Corp.)

Flexibility of Operation

Essential in war production..
Vital to peacetime operation

FOR many years flexibility of operation has been a "built-in" feature of McKee-designed refinery units. Because of this "built-in" flexibility, modern McKee-engineered plants can be more readily adapted to the rapid developments in petro-chemistry.

Many new uses of petro-chemical products in a post-war economy will make flexibility of operation a vital necessity of successful peacetime refinery operation.

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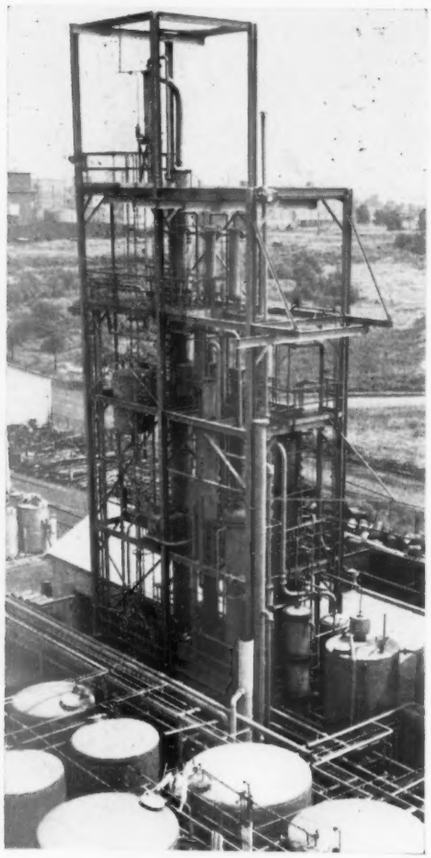


The first commercial plant for the vapor phase nitration of petroleum hydrocarbons. Nitroparaffins and their derivatives are among the important recent petroleum chemical developments. Useful as versatile solvents and parent substances for a host of chemical derivatives, the nitroparaffins seem destined to play an important role in the postwar world. (Photo from Commercial Solvents Corp.)

Company Organization

Returning to the question of company organization, let it be assumed that desirable products with promising futures have been determined and that the company can see its way clear to answer the questions of raw materials and equipment. What type of organization, then, should be built to direct efforts in this new phase of the refining business? The company, if it is large, presumably has a research division; should this new endeavor be placed under its supervision or under joint control? If the company is small and conducts its bit of research as a phase of engineering, should a separate department for chemical manufacture be set up? Should the company concerned create a manufacturing subsidiary to handle such operations? Or, finally, should the petroleum company seek out a large potential user of its products, such as a chemical concern of long experience or a volume producer of consumer goods, and organize a jointly-owned subsidiary to which it will contribute raw materials and process experience while its partner will provide chemical technology and market knowledge?

This series of questions should be considered carefully. Each method of solution has particular merit under certain circumstances. If patents perchance are involved, the choice becomes easier: Mohammed would have found it easier if the mountain could have gone half way. Degree of integration of the petroleum company is also a factor. A chemical company should not be tacked onto a corporate edifice unless there is room for its efficient management.

Industrial Research

Few companies enter a field of manufacture unless they feel reasonably certain that their processes are sound, that their raw materials are assured, and that their market position will enable them at least to hold their own with competitors. Twenty years ago these factors would have been all that mattered; today they hardly would guarantee sufficient income to amortize equipment. Change is the order of the day. The factor of obsolescence holds the final answer to the success or failure of any process or enterprise.

Obsolescence—the price of progress—can be compensated for in one of two ways. A company can try to amortize its process over an artificially short period of time, a period so short that fear need not be felt that competitors can enter the field in sufficient numbers or with competing products in sufficient quantity to disturb financing. This method is obviously unwise and equally obviously could be practiced in few instances. No company bases its policies on a series of windfall processes, but rather on those which give reasonable promise of steady profit. The alternative to such a program has been adopted by most enterprises interested in an insurance policy for the future—industrial research, protected by an adequate patent program and other features of keen management.

The subject of industrial research has received so much attention in recent years that the basic facts and reasons for its existence are now accepted generally. Of course a company could depend upon licensing the technical developments of other companies—when licenses are available—but here again timing is the important factor. Ayres[2] has expressed this idea concisely:

"Technical obsolescence must be regarded as of the utmost importance in the present argument. If we pay a million dollars as paid-up royalties for a certain process, this may not seem to be a serious expense if we can assume that this process will not become obsolete. But this is frequently not the case. By the time we get this process in operation, it will be somewhat obsolete, and by the time we install its successor and get it into operation this also is likely to be obsolete. Paid-up royalties cannot be regarded as non-recurring expenses because technical obsolescence sees to it that such expenses recur with dismal regularity.

"It appears that process research should be justified (1) by its saving of many times its cost by the reduction of the other greater developments costs, and (2) by its effect upon the vital element of timing. Either one of these reasons is sufficient in itself and it is unnecessary to include the reason that research may enable us to charge royalties or to be immune from paying royalties. This last factor has to do not with the justification of research, but rather with the justification of patent prosecution. There is no reason to compare the cost of research with the cost of royalties. The comparison should be between the cost of patent prosecution and the amount of royalties received plus the amount of royalties which otherwise we would have to pay."

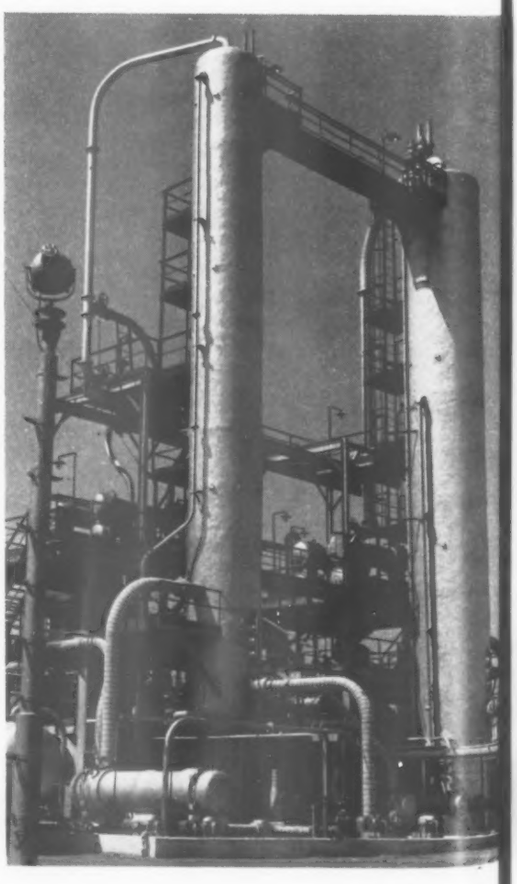
It has been pointed out, also, that "research undertakings frequently necessitate the expenditure of large amounts of time and money in order to bring a development into commercial production. Obviously, no company wishes the fruits of its labor to become available to its competitors without compensation. A well-rounded program for the procurement of patents . . . is the insurance policy that the research results will not be unfairly exploited by others[4]."

For the small company, of course, large-scale research is impractical. It must be remembered, however, that many of today's industrial giants came into existence as small entities and developed through proper exploitation of ideas and materials at hand. For major refining developments such as catalytic cracking or isomerization the small refiner is almost forced to depend upon licensing, but the petroleum chemical industry is different. Here ingenuity is at a premium and may and often does outweigh the advantages of large research organizations.

[2]Eugene Ayres, "The Evaluation of Research," *Petroleum Refiner*, 21, No. 10, 366 (1942).

[4]Private communication from W. H. Deitch, Gulf Research & Development Co.

A butane fractionation unit. Butane, from refinery units such as this, today finds vital applications for the synthesis of butadiene from synthetic rubber and isobutane for aviation gasoline. (Photo from Esso Marketers)



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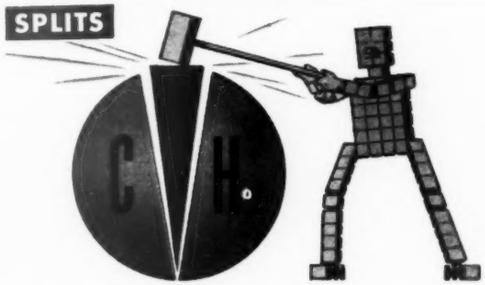

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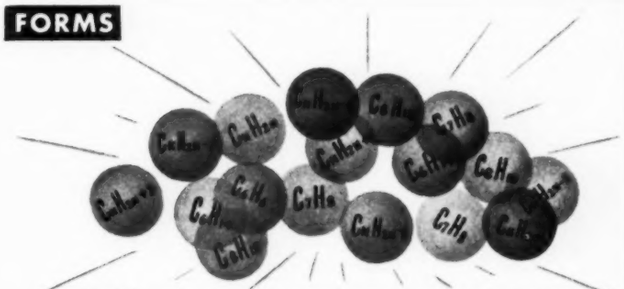

2 **Highly activated, stable and new in principle, Filtrol Catalyst enables refiners to plan more and faster production for these vital and essential materials because of its proven capacity to control the conversion of petroleum stocks. Only Filtrol Catalyst is precision-controlled and laboratory tested.**

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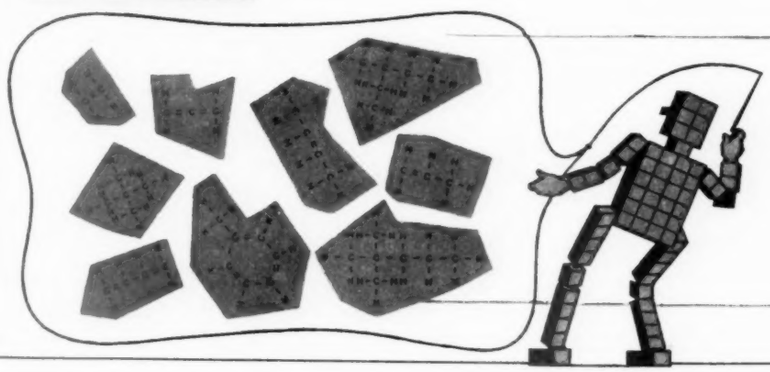

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FILTROL CATALYST *to Speed Victory*

A High-Vacuum Rectifying Column Employing Multiple Redistillation*

By Robert M. Schaffner†, John R. Bowman‡ and James Coull§

A high-vacuum still is described which incorporates a new type of rectifying column for securing compounds of a higher degree of purity than is attained with present columns of conventional design. This type of column may find commercial application in petroleum refining in supplying pure heavy hydrocarbons for chemical intermediates and other purposes where purity of product is essential even at higher costs.

The column is a vertical unpacked tube having alternate segments heated and cooled. In operation the vapor rises unimpeded through the tube while the reflux flows downward as a thin film on its inner surface. At each of the heated zones a portion of the reflux is vaporized and the vapor so formed mixes with the main vapor stream at that point. Similarly, at each cooled zone a portion of the vapor stream is condensed and the condensate mixes with the main reflux stream at that point. The column thus has an alternate action in stripping the light components out of the reflux and condensing the heavy ones out of the vapor.

As is well known, ordinary methods of rectification cannot be applied to distillations at pressures under a few centimeters. The pressure drop in bubble plate columns is several orders of magnitude larger than the pressure desired in the still pot for high vacuum work, and the same is true of packed columns unless the throughput is vanishingly small. Further, even if pressure drop difficulties could be overcome, exceedingly large interface area would be required between vapor and reflux because the vapor density is so low at these pressures that the spontaneous adiabatic approach to equilibrium is very slow. The column to be described avoids both difficulties by providing a straight-through passage of large cross-section for the vapor, and positive control of the condensation of the heavy components from the vapor and vaporization of the light ones from the reflux.

Principles

The column is a tube, preferably straight and vertical, in which vapor flows upward unimpeded, and the reflux downward as a film on the inner surface. It differs from the usual types of unpacked columns in that heat is applied to and abstracted from alternate segments or bands, respectively. Any number of pairs of bands may be used, depending on the separating power desired.

The heated zones act as miniature stills, vaporizing a part of the main reflux stream as it flows past them, and the cooled ones act as partial condensers, condensing a portion of the main vapor stream passing through them. The vapor and condensate so formed are immediately mixed with the main vapor and reflux streams at the points at which they are formed, respectively, bringing about an alternate enrichment of vapor and reflux. Fig. 1 illustrates a flow scheme for a length of column including two pairs of exchange zones.

A laboratory-scale still has been built having a column embodying the above principles; see Fig. 2. All glass construction was used throughout. The column is a tube 38 mm. (1.5 in.) in diameter, and about 150 cm. (5 ft.) long. It is provided with 12 heated zones separated by 12 cooled ones, with one of the latter at the top.

The heated zones are about 5 cm. (2 in.) long and have a uniform winding of Nichrome wire on asbestos paper on the outside; the heating current is supplied to these in series from a large Variac transformer. On the inside of the tube at these sections there is placed a close-fitting helix of 3 mm. (⅛ in.) Kovar rod having a pitch of about 6 mm. (¼ in.); this is for the purpose of retarding the flow of the reflux, increasing its surface, and aiding in the mixing of the reflux with the condensate from the cooled zone above.

The cooled sections are simply unmodified portions of the glass tube having compressed air jets impinging on the outside. The air line to the jets is provided with a filter, a pressure regulator, a valve for manual control of cooling, and finally a manometer to indicate the extent of cooling.

Reflux is supplied by a partial condenser. This is an extension of the column 15 cm. (6 in.) long having both a nichrome winding for heating and air jets for cooling. The former is necessary for high temperature work and the latter is used for low temperatures. Above the partial condenser is provided a total condenser of conventional design.

An optical glass thickness gage (Bausch and Lomb Co.) is employed to determine the thickness of the reflux film at any point of the column, and hence to measure the extent of vaporization condensation and reflux ratio. Details of its use are given in the next section.

The other parts of the still are of conventional design. The still-pot is spherical and of 2-liter capacity. It is electrically heated, and provided with a thermometer well and a filling neck with a ground glass stopper. For distillation of small amounts of material, or for distillation nearly to dryness, the charge is floated on a layer of Wood's metal. The condenser is both air and water cooled. Stopcocks are provided to permit changing receivers during the distillation without interrupting its course. Pressure is measured at the cold end of the condenser with a McLeod gage.

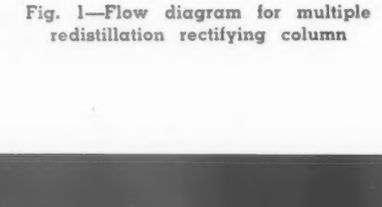

Fig. 1—Flow diagram for multiple redistillation rectifying column

Operation

The starting of a run with a still of the present type requires some care. After vaporization begins in the still-pot, some heat must be supplied to the heated sections or the column will function as a total reflux condenser. At temperatures below 150° C. this offers no difficulty, but for high temperature distillations up to 350° C., so much heat must be used to keep the vapor rising in the column that the upper dry zones will overheat seriously, and decompose the vapor thermally when it reaches them. In these cases, it is necessary to turn on the hot zones one at a time, starting from the bottom and waiting for the vapor and reflux to reach the next one before turning it on.

After the vapor and reflux reach the top of the column, full air blast is turned on the partial condenser, causing it to operate as a total condenser. The heat on the heated zones is now increased to the desired amount and the air supply to the cooled ones adjusted.

The adjustment of the rates of heating and cooling requires some comment. As is well known in molecular distillation theory, the maximum rate of vaporization obtainable at a given temperature is finite and given by the Langmuir formula:

$$n = PA\sqrt{\frac{1}{2\pi MRT}}$$

where n is the vaporization rate in moles/sec., P is the vapor pressure, A the area of the exposed

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†Based on Doctoral Dissertation of R. M. Schaffner, Department of Chemical Engineering, University of Pittsburgh (1941); present address, research department, Standard Oil Co. (Ind.), Whiting, Ind.

‡Industrial Fellow, Mellon Institute, Pittsburgh.

§Head of Department of Chemical Engineering, University of Pittsburgh.

surface, M the molecular weight, T the absolute temperature, and R the ideal gas constant. This rate is very nearly obtained when a liquid distills into a very high vacuum or is strongly superheated. The present still does not provide the conditions of molecular distillation, but, nevertheless, the vaporization taking place in the heated zones is largely limited by the above formula because the time of contact is short and a large fraction of the reflux stream must be vaporized in that time. Extreme superheating is therefore necessary at the heated zones if good separation is to be achieved. In practice, superheats of 100-150° C. have been used; the reflux liquid does not boil with bubbling even under these extreme conditions, but merely evaporates quietly and rapidly as in molecular distillation.

When maximum separation is desired, therefore, the heat input to the hot zones should be such that the temperature rises to the maximum temperature that the distillate will stand without pyrolysis, and the air jets of the cooled zones adjusted so that flow is uniform throughout the column. The latter condition insures that the extent of condensation in the cooled zones is equal to the extent of vaporization in the heated ones. After the heating and cooling rates have been adjusted, the still should be run some time at total reflux, as is usual with conventional columns, and then the distillation proper begun and continued with as large a reflux ratio as is feasible. A quantitative discussion of the dependence of the separation on vaporization, condensation, reflux ratio and throughput is given in another section. The action of the still is rather stable, and the variables require little if any adjustment during the course of a run on a reasonably narrow-boiling mixture.

The several liquid flow rates along the column are measured with an optical glass thickness gage, depending for its action on superposition of the images of a scale reflected from the outer surface of the glass tube and from the inner surface of the flowing reflux film. A third reflection, that from the inner surface of the glass tube is usually visible, but is feeble and does not interfere, particularly when the refractive index of the material being distilled is near that of Pyrex glass. Since the apparent thickness of the flowing film depends on its refractive index, and since the flow rate is proportional to the cube of the thickness and to the viscosity, the gage must be recalibrated for each material and temperature. For this calibration the thickness of the dry column is measured at marked points. The still is now operated at zero reflux and the total throughput measured. Then the still is operated at total reflux, and the film thickness measured by difference at the same points. The constant of proportionality between the flow rate and the cube of the film thickness can then be calculated, and used for adjusting the operation of the still during the run. The apparent film thickness can be read to 0.001 in. (0.025 mm.) and reflux flow rates can be determined to within about 5%.

After calibration of the gage, the measurement and adjustment of the operating conditions are very simple. The total throughput is measured while the column is coming to equilibrium under total reflux. Gradual reduction of the heat on the partial condenser will

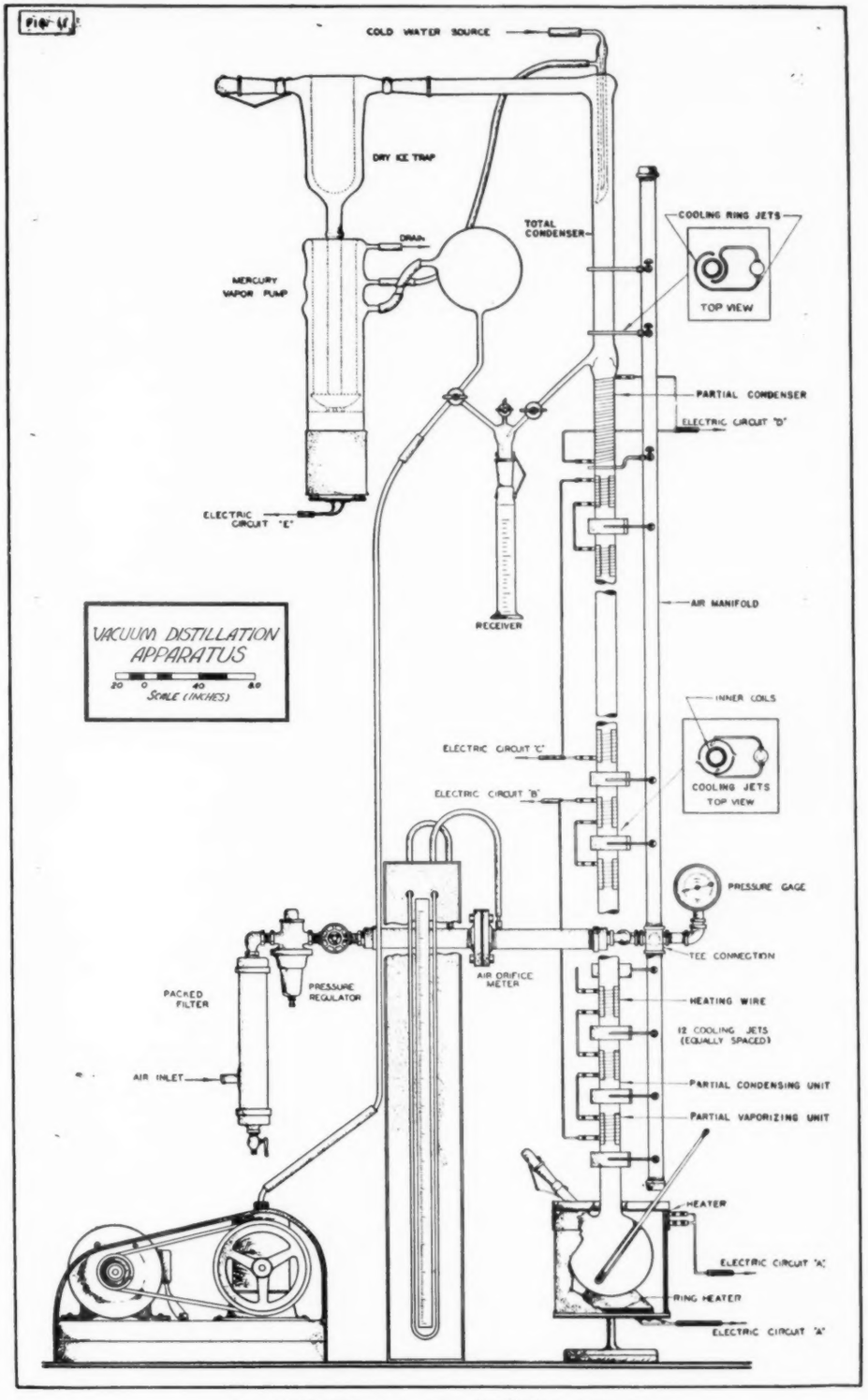

Fig. 2—Sketch of vacuum distillation apparatus

then permit collection of product and the total reflux flow can be measured for calculation of the reflux ratio. The extents of vaporization and condensation can be obtained readily by measurement of film flow at points where hot and cold zones meet; three successive such points are sufficient.

The throughput must not be made too large. This is necessary both from the theory of the ideal operation of the column and from the fact that excessive vapor velocities may prohibit adequate mixing of the main vapor stream and the vapor produced in the heated zones. There exists, certainly, a critical relation between the bore of the column, the mean free path of the molecules in the vapor, the length of the sections, and the vapor velocity such that a greater vapor velocity will show much poorer separation. In practice, however, this causes no difficulty in the present column at pressures of 0.1 to 0.01 mm. Hg with throughput rates of about 250 ml./hr.

Before a rigorous treatment of the ideal performance of the column can be given, cer-

tain simplifying assumptions must be made. Unfortunately, most of these affect the problem in the direction of enhanced separation, but the set selected appear to be the mildest that will permit any calculations at all to be made.

First, it must be assumed that perfect mixing takes place. As the vapor rises into a heated zone, it is assumed to be entirely homogeneous as to composition and similarly, as the reflux film flows downward, it is assumed that the condensate from the last cooled zone has become thoroughly mixed with the main stream before the combination of the two enters the next heated zone. Actually, the mixing in the vapor phase probably offers no difficulty; diffusion at the pressures prevailing is exceedingly rapid. Mixing in the liquid phase is probably less nearly ideal. Conditions here, however, are as favorable as possible without actual mechanical agitation, as the components to be mixed flow some distance as a very thin, initially stratified film, and the flow is interrupted by passage over the Kovar helices.

Second, the operations of evaporation and condensation are assumed to be of the differential type. In the case of the partial vaporization of the reflux, this condition is obviously nearly realized because vaporization occurs progressively as the film flows through the heated section, and the liquid is so strongly superheated that little condensation takes place. Mixing enters here again, as the film might possibly become heterogeneous by loss of light components from its surface, but that effect is small. The partial condensation in the cooled zones is certainly very efficient and nearly differential in nature. The process is known to be a rather inefficient one at higher pressures as a consequence of stratification phenomena, but at the low pressures in the column, diffusion should help produce nearly ideal results.

Strictly speaking, the assumption of differential evaporation in the heated zones is incompatible with the laws of viscous flow. If the mixing is not instantaneous, the light-lean surface of the film will move downward faster than the portions of the film near the glass surface, and reduce the efficiency of the separation. Calculation of the magnitude of this effect is not feasible.

Calculation of Performance

On the basis of the assumptions of the preceding section, the performance of the column is readily calculated inversely, that is, the number of sections to produce a distillate of required composition, when the composition of the charging stock is given, can be computed numerically. This is equivalent to calculation of the composition required of the charging stock when a certain distillate, the number of units, and the operating conditions of the column are given.

The direct problem, the determination of the composition of the distillate when the operating conditions and the number of units in the column are given, cannot be solved readily except by interpolation of the results of calculations on the inverse problem.

Let V_n and L_n denote the number of moles of vapor and liquid, respectively, passing the *upper* boundary of section n per unit time; that section will be a heated or cooled one according to whether n is odd or even, respectively. For constant molal flow conditions, the amount (in moles) of material vaporized per unit time in the heated sections must equal the amount of material condensed in the cooled ones; let that amount be Z.

At the upper boundary of any section, four quantities are of interest: the compositions of the liquid and vapor phases, x_n and y_n (as mole fraction of light component) respectively, and the rate of flow of the two total phases, liquid and vapor, L_n and V_n (in moles per unit time) respectively. It will now be shown that, given these four quantities for any section boundary n, the values of the four quantities obtaining at the upper portion of section n—1 may be calculated.

Obviously, from total material balances through a heated section **n:**

$$L_{n-1} = L_n - Z \qquad \text{n odd} \qquad (1)$$

$$V_{n-1} = V_n - Z \qquad \text{n odd} \qquad (2)$$

The composition of the reduced reflux, x_{n-1}, emerging from the heated section **n** may be obtained from the well known Rayleigh equation when Raoult's law can be assumed, given by

$$\ln \frac{L_n}{L_n - Z} = \frac{1}{a-1} \ln \left[\frac{x_n(1-x_{n-1})}{x_{n-1}(1-x_n)} \right] + \ln \frac{(1-x_{n-1})}{(1-x_n)}; \text{ n odd} \qquad (3)$$

Once x_{n-1} is obtained, the composition of the vapor, y_{n-1}, is readily calculated by taking a material balance on the light component:

$$y_{n-1} = \frac{y_n V_n + x_{n-1} L_{n-1} - x_n L_n}{V_n + Z}; \text{ n odd} \qquad (4)$$

Similarly, but conversely, the equations for passing downward across a cooled section may be obtained, and they are:

$$V_{n-1} = V_n + Z \qquad \text{n even} \qquad (5)$$

$$L_{n-1} = L_n + Z \qquad \text{n even} \qquad (6)$$

$$\ln \frac{V_n + Z}{V_n} = \frac{a}{1-a} \ln \left[\frac{y_{n-1}(1-y_n)}{y_n(1-y_{n-1})} \right] + \ln \frac{(1-y_n)}{(1-y_{n-1})} \text{ n even} \qquad (7)$$

$$x_{n-1} = \frac{x_n L_n + y_{n-1} V_{n-1} - y_n V_n}{V_n + Z} \text{ n even} \qquad (8)$$

The determination of x_{n-1} for a heated section, and y_{n-1} for a cooled one requires the inverse use of the Rayleigh equations. This is inconvenient analytically, because the equations are not readily solvable for these variables, but the following graphical method may be used. Equations (3) and (7) may be written, respectively

$$p(x_{n-1}) = \ln \frac{L_n}{L_n - Z} + p(x_n), \text{ n odd} \qquad (9)$$

$$p(1-y_{n-1}) = \ln \frac{V_n}{V_n + Z} + p(1-y_n), \text{ n even} \qquad (10)$$

where

$$p(x) = \frac{1}{a-1} \ln \left[\frac{1}{x} - 1 \right] + \ln(1-x) \qquad (11)$$

These forms of the Rayleigh equations are amenable to graphical calculation, once the function $p(x)$ is plotted; such a graph is given in Fig. 3. All of the quantities on the right sides are known, and that side may readily be evaluated numerically. This done, the p functions on the left side, containing the unknowns to be evaluated are easily inverted and the roots determined.

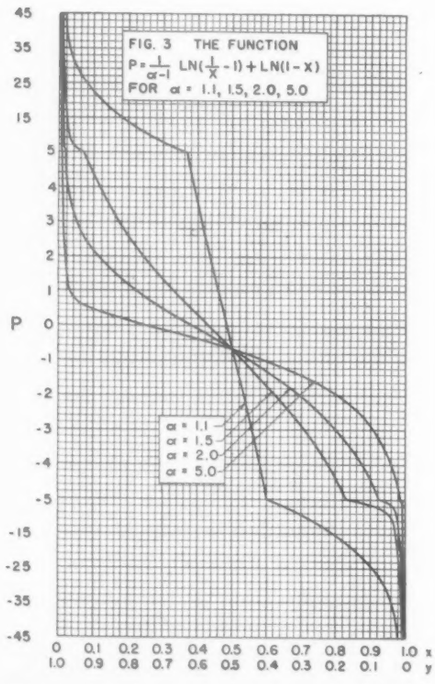

Fig. 3—Graph for calculation of Rayleigh calculations

In the case of total reflux, the calculations are greatly simplified by the relations

$$L_n = V_n \text{ n odd or even} \qquad (12)$$

$$x_n = y_n, \text{ n odd or even} \qquad (13)$$

For systems containing components not following Raoult's law, the general form of Rayleigh's equations,

$$\ln \frac{L_n}{L_{n-1}} = \int_{x_{n-1}}^{x_n} \frac{dx}{y-x}, \quad \ln \frac{V_n}{V_{n-1}} = \int_{y_{n-1}}^{y_n} \frac{dy}{x-y} \qquad (14)$$

must be integrated graphically. This is not usually difficult.

Since the method for calculating flows and concentrations stepwise down the column has been established, all that remains is the choice of these quantities at the top of the column. When a total condenser is used,

$$x_t = y_t, \qquad (15)$$

or, if a partial condenser is used in conjunction with a total one to provide reflux, as is convenient in high vacuum work, the relation between x_t and y_t is best obtained from Rayleigh's equation. The relation between L_t and V_t is almost equally simple; for total reflux,

$$L_t = V_t, \qquad (16)$$

while at partial reflux, there are the conven-

Anhydrous HF

FOR THE ALKYLATION PROCESS

OUT of the ever-growing demand for 100 octane gasoline has sprung a new catalytic alkylation process for the manufacture of this powerful fuel. This process will materially speed up the output of 100 octane gasoline, and help to keep our swelling air force flying high.

The catalyst in this new process is anhydrous HF, which was first produced in quantity by Penn Salt's Easton, Pa., plant (formerly the Sterling Products Co.).

To keep pace with the need for 100 octane gas, Penn Salt has expanded its production of anhydrous HF, and can supply users with this important catalyst—either in tank cars or cylinders. And, by reason of long experience in the manufacture of acids, Penn Salt is equipped to give sound technical advice to users. Address all inquiries to Pennsylvania Salt Manufacturing Company, 1000 Widener Building, Philadelphia, Pa.

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tional relations

$$L_t = DR \quad (17)$$

$$V_t = (R - 1)D \quad (18)$$

where D is the number of moles of distillate product removed per unit time, and R is the reflux ratio. Extension of the method to columns of the present type having intermediate feed or side stream product lines is obvious.

Summarizing, to calculate the feed composition required to produce a distillate of given composition, $x_n (= y_n)$, from a still with n (n even) units, at a reflux ratio R, select the maximum throughput, V_n, and the maximum practical vaporization-condensation rate, Z, and calculate L_n from Equation (17). The quantities L_n, V_n, x_n and y_n, together with Z are now known, and by the use of Equations (5), (6), (10) and (8) the four quantities may be determined for the point $n - 1$, which is the point at the base of the top cooled section and at the top of the last heated section. Similarly, now, the values of the four variables at the point $n - 2$ are determined, using the values found for the $n - 1$ position and Equations (1), (2), (9) and (4). The process is repeated until the feed composition is reached at the bottom of the still.

Discussion of Ideal Performance

Several calculations have been made for the performance of columns of the present type under various operating conditions and separating hypothetical binary mixtures having various values of the volatility ratio; the results are given in terms of theoretical plates per hot-cold pair of units in the column, at the same reflux ratio. The results of these calculations are listed in Table 1.

Some striking qualitative results may be derived from inspection of these data. These, however, must not be extrapolated too far on the basis of the limited figures calculated, but they do serve to show that the performance characteristics of these columns are widely different in nearly all respects from conventional types.

The effect of varying the extent of vaporization-condensation action, Z, is shown by Examples 1 to 4. The results of these calculations indicate that, as is to be expected, an increase of Z greatly increases the separating power of the column; the separating power ranges from zero when Z is zero to infinity when Z is infinite.

The effect of reflux ratio is demonstrated by Examples 2, and 5 to 8. The rectifying power is, as in conventional columns, increased by increasing the reflux ratio, approaching a limit asymptotically for total reflux, but the present type of column is not as dependent on high reflux ratio as are usual ones. As the reflux ratio is decreased from infinity, the performance improves when compared to that of a column of theoretical plates operated at the same reflux ratio.

Examples 2, and 9 to 12 show the effect of varying the throughput, keeping other quantities constant. This, effectively, is identical to varying the vaporization-condensation, Z, and the results are the ones to be expected. Examples 5, and 13 to 15 give similar data, but with partial reflux, and show no remarkable effects.

TABLE 1 — Calculations for Ideal Performance

Example Number	Distillate Composition (x_t)	Reflux Ratio (R)	Moles of Throughput (V_o)	Moles Vaporized and Condensed (Z)	Volatility Ratio (α)	Ratio of (V_o/Z)	Number of Unit Pairs (n/2)	Composition of Vapor Entering Column (y_o)	Mean No. of Plates per Pair
1	0.80	Total	1.00	1.20	1.5	0.83	3	.370	1.5
2	0.80	Total	1.00	1.00	1.5	1.00	3	.424	1.4
3	0.80	Total	1.00	0.80	1.5	1.25	3	.489	1.2
4	0.80	Total	1.00	0.50	1.5	2.00	3	.593	0.8
5	0.80	9	1.00	1.00	1.5	1.00	3	.461	1.7
6	0.80	7	1.00	1.00	1.5	1.00	3	.465	1.8
7	0.80	5	1.00	1.00	1.5	1.00	3	.478	2.0
8	0.80	3	1.00	1.00	1.5	1.00	3	.510	2.3
9	0.80	Total	0.50	1.00	1.5	0.50	3	.203	1.9
10	0.80	Total	1.50	1.00	1.5	1.50	3	.534	0.6
11	0.80	Total	2.00	1.00	1.5	2.00	3	.602	0.5
12	0.80	Total	2.50	1.00	1.5	2.50	3	.639	0.3
13	0.80	9	0.50	1.00	1.5	0.50	3	.299	3.2
14	0.80	9	1.50	1.00	1.5	1.50	3	.604	1.2
15	0.80	9	2.00	1.00	1.5	2.00	3	.644	1.0
16	0.80	Total	1.00	1.00	1.5	1.00	6	.115	1.4
17	0.80	Total	1.00	1.00	2.0	1.00	3	.340	0.9
18	0.90	Total	1.00	1.00	1.5	1.00	3	.530	1.7

Column units for the present type, appear to add in nearly or quite the same manner as for bubble plate units, as may be seen by comparing examples 2 and 16. This has not been demonstrated mathematically, and is somewhat surprising, but is definitely correct within the error of the present graphical method of performance calculation.

The efficiency of a column of the present type, measured by the equivalent number of theoretical plates, increases rapidly as the volatility ratio of the materials being separated decreases toward unity. These columns, therefore, are particularly suitable for rectifying mixtures difficult to separate. As the volatility ratio decreases, the separation, of course, does also, but the performance of the still, measured by conventional standards, increases. Examples 2 and 17 illustrate this.

A similar effect is obtained on increasing the required concentration of light component in the distillate; the concentration of it required in the feed is increased, but not nearly as much as in the case of conventional columns; this is shown by Examples 2 and 18.

Experimental Tests

There are very few data in the literature on the relative volatility of systems suitable for testing the rectifying efficiency of high vacuum stills; those of Bishop[1] on the system of meta- and para-tricresyl phosphates is considered best, and was used to determine the practical performance of the laboratory model still described above.

The measurement of the temperature of the heated zones offered a difficult problem. From the considerations discussed above, a large extent of superheating is to be expected, but since the temperature desired exists only on a small surface, conventional methods of measuring it proved to be unsatisfactory. The best results were obtained indirectly, using the system dioctyl phthalate-di(butoxyethyl) phthalate.

TABLE 2 — Summary of Experimental Performances

Run	A	B	C	D
Charge (% meta)	19	19	19	19
Distillate (% meta)	50	59	54	49
Film thickness, top of cooled unit, mm.	0.007	0.008	0.008	0.007
Film thickness, bottom cooled unit, mm.	0.012	0.017	0.022	0.026
Throughput, cc./min.	3	3	3	3
Reflux ratio, R	2	2	2	2
V_t/Z	0.155	0.044	0.021	0.013
Equivalent number of plates in column	14.2	18.1	15.8	13.8
Performance of one unit, equivalent number of plates	1.18	1.51	1.32	1.15

The volatility ratio for this system passes through unity at 662° F. (350° C.), and the vapor pressures are of the same order of magnitude as those of the phosphate system. Operation of the still on the phthalate system gave, surprisingly, a small negative enrichment, when the volatility ratio was so chosen that the light component was the one more volatile at low temperatures. The value 662° F. (350° C.) was therefore chosen as a conservative lower limit for the operation of the hot zones on the phosphate system under the same conditions. This choice of temperature is to be regarded as conservative, because the volatility ratio for the phosphate system decreases with increasing temperature, and choice of a temperature too low would give performance efficiencies too low.

The volatility ratio of the phosphate system at 662° F. (350° C.) is 1.10; this value is used throughout the calculations.

The experimental results and the performance data calculated from them are listed in Table 2. The only quantity varied in these test runs was the vaporization-condensation, Z.

A glance at these figures shows several important facts. The efficiency is very low compared with the theoretical, probably for reasons discussed earlier in the paper. Further, increase of Z to very large values does not increase the separation nearly as greatly as predicted by theory. This is probably in part also because of the same reasons, but in addition, may be caused partly by the failure to obtain equilibrium with regard to time. When Z is large, qualitative considerations indicate that the column must be operated for a long time at total reflux to obtain equilibrium, and, similarly, equilibrium is obtained only rather slowly at partial reflux. Continuous operation might give results much more nearly those calculated, especially under conditions of large Z, and large reflux ratio.

The performance of the still, however, is to be considered remarkable for rectification at such low pressures, and is far better than that of any other apparatus known to the writers.

Table of Nomenclature

D = Distillate product removed, mols per unit time
L_n = Flow of reflux into unit n, mols per unit time
p = Generalized distillation function, see Equation (9)
R = Reflux ratio
V_n = Flow of vapor out of unit n, mols per unit time
x_n = Composition of reflux at top of unit n, mol fraction light component
y_n = Composition of vapor at top of unit n, mol fraction light component

[1] Bishop, C. A., Ph.D. Thesis, University of Pittsburgh, 1942.

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Expanding Uses for Synthetic Rubber Seen in Peace As Well as War

Some oil companies have been reported hesitant to embark on the uncharted seas of butadiene manufacture for fear that natural rubber will put synthetic rubbers into the discard when the war is over. Their fears are groundless, according to W. D. Parrish, rubber technologist Hycar Chemical Co., Akron, an affiliate of Phillips Petroleum Co. and B. F. Goodrich Co.

"The many superiorities of synthetics over natural rubber have been so firmly established by the gruelling tests of war that these new materials will never be replaced by natural rubber, regardless of their availability or price," this authority declares. He goes on to state that these vehicles of war—warships, submarines, bombers, fighter planes, jeeps, tanks—could not operate if they relied on natural rubber.

These views of a rubber company authority are presented by the Hycar Chemical Co. in response to requests from the industrial field for more information about synthetic rubber, what it is doing in the war, how it compares with ordinary rubber, and what future possibilities it promises. The major portion of the discussion follows.

By W. D. Parrish

SYNTHETIC rubber has one pronounced advantage over the natural material—it can be varied in the basic crude state through modifications in its manufacture. From the public's more immediate viewpoint, the most notable record is probably that of passenger automobile tires composed of synthetic rubber. Synthetic rubber tires have already been produced with wearing qualities comparable to natural rubber, which required more than 40 years' experience in compounding to bring it to its present high standard.

If the improvement in synthetic rubber continues at the rate of the past 2 years as a result of further development of compounding materials specifically for use with the synthetics, it will not be unreasonable to expect the production of synthetic tires to last the normal life of the car. This is indicated in a recent test run in which synthetic rubber tires, under 35% overload, traveled 37,000 miles at 60 miles an hour. This test was made to determine the value of a new carbon black (reinforcing agent) manufactured specifically for synthetic rubber. This is just one example of a compounding ingredient developed primarily for the synthetics and the results are suggestive of what further development will bring about.

Resistance to wear is only one quality in which these synthetics excel. They have greater resistance to oil, gasoline and similar fluids that cause natural rubber to soften and lose its original properties. They have greater resistance to the effects of heat and oxidation, the influences that cause rubber to crack and fall apart with age.

In many parts of airplane construction, the aircraft designer takes advantage of the unusual qualities of synthetics. The self-sealing gasoline tank has saved the lives of countless American aviators by its unique ability to instantly "heal" its own bullet wounds. Before the advent of the synthetics, these tanks would have been out of the question because gasoline destroys natural rubber and, therefore, prevents it from being used as a flexible liner to form a barrier between the gasoline and the sealing materials.

In the airplane as in the automobile, gaskets, seals, packings, resilient fittings and hose made of synthetic rubber are used where such parts are exposed to oil, sunlight or heat. In this service, ordinary rubber would be out of the question; only by the use of synthetic rubber has modern aviation been made possible.

In the operation of tanks, synthetic is standing up under extreme conditions. In a California test, tank tread blocks made of a special synthetic outlasted natural rubber approximately one and one-half times. The cooling liquid in tank engines reaches a temperature of 250-300° F., or more than 100° hotter than the water in an ordinary automobile radiator. Connections of synthetic must be used at that temperature because rubber would be immediately destroyed by the heat and the coolant.

Because butadiene synthetics are superior to natural rubber in ability to absorb vibrations, they are being used in engine mountings for tanks, trucks and jeeps where continued operation under adverse conditions is paramount. Under the gruelling conditions of the North African campaign, the new synthetics with their remarkable resistance to oil, abrasion and heat, are helping in a unique way to bring victory to the United Nations.

In this campaign, the armies consumed enormous quantities of gasoline. This had to be stored, and storage meant that big metal tanks had to be shipped from the U. S. in small segments that could be nested in the holds of vessels. The question as to how to fasten these segments together to prevent leakage was solved when gaskets of synthetic rubber were used to seal the joints, since natural rubber could not be used because of its poor resistance to gasoline.

Barrage balloons are made of synthetics chiefly because of their higher resistance to sunlight and their greater ability to contain gases. The resistance to abrasion of these new materials gives an enduring quality to floor coverings in warships and other war vehicles that receive hard usage and particularly where oil, gasoline and greases are present.

(*Editor's Note: Some of the laboratory tests for synthetic rubbers discussed by Mr. Parrish and deleted because of space requirements, are abstracted briefly below. They are included as examples of experimental determinations which have resulted in the war-uses previously mentioned, and the projected peacetime uses forecast in the concluding portion of the discussion.*)

Abrasion Resistance: The relative wearing ability of natural and synthetic rubber is determined by subjecting both materials to the same abrasion test, and weighing the amount worn off of each. Such a test has shown that some synthetics have an abrasion resistance approximately 30% greater than natural rubber.

Heat Resistance: Many comparison tests of the heat resistance of natural and synthetic rubber have been run. One such test, for instance, showed that natural rubber is considerably softened upon immersion in water at the boiling point—212°F.—while the synthetic was scarcely affected. In another test, natural rubber lost practically all of its elasticity and tensile strength when heated for 35-40 hours at 300°F.; a synthetic hardened slightly, but increased somewhat in tensile strength.

Resistance to Metallic Action: It has long been known that natural rubber deteriorates rapidly when in contact with copper or copper-bearing alloys. This has been a serious disadvantage in insulating copper wire, use of rubber hose connections to copper tubing, or use of rubber gaskets, diaphragms and valve discs in copper alloy shut-off and regulating valves. Indeed, it has been customary to tin-plate these alloys to prevent rubber-to-copper contact. Some of the synthetics, however, show no deteriorating effect when in contact with copper. Moreover, it has been learned that synthetic rubber may be bonded to many metals just as porcelain is bonded to steel in the common refrigerator.

Resistance to Gasoline and Oil: Ordinary and synthetic rubber were soaked in 100-octane aromatic gasoline, containing 40% of a mixture of benzene, toluene and xylene—all notorious for their rubber dissolving action. The synthetic swelled slightly while natural rubber in the same length of time swelled several hundred per cent and lost all its usefulness.

In discussing the future possibilities of synthetic rubber in the post-war world, Mr. Parrish holds no fear that synthetics will be relegated to the background when ample supplies of natural rubber again become available. "Tomorrow's automobile and countless other improved articles for use in the home and in industry will be made possible by synthetics now taking the place of natural rubber," he stated. "Already many future planners are including these new compounds in their specifications of products for the home, the farm, transportation and countless other industrial and com-

mercial applications." His discussion continues:

The oil and heat resisting properties of the synthetic will prove of utmost importance in permitting the design of automobile engines which will be far superior to present-day types in power, speed and operating economy. They will deliver 40 to 50 miles per gallon of gasoline.

Synthetic rubber will bring to an end 2 annoyances of the motorist—the boiling and freezing of radiators. The cooling liquid will be sealed in so it cannot evaporate and the coolant itself will be ethylene glycol or a similar chemical which does not freeze in ordinary winter temperatures.

To give greater power, efficiency and economy, the engine will operate at temperatures 100°F. higher than present types, according to reports from the automotive field. Because of its resistance to oil, heat and cooling liquids, synthetic rubber will doubtless be specified for the flexible connections, gaskets and packing in the cooling system, and in the oil and fuel lines.

Synthetics also have a vibration absorbing quality much superior to that of natural rubber and therefore will be more useful than rubber as engine mountings. They are even being considered for automobile springs. Under discussion also is their use in clutches entirely submerged in oil. The greater heat and abrasion resistance of synthetics likewise, should make it useful as brake linings.

In many industries where oil and chemicals destroy natural rubber, synthetics will find numerous applications in machinery and equipment for producing, storing, shipping and handling these materials.

The new synthetics taking the place of ordinary rubber are creating an entirely new class of engineering materials, giving engineers a much greater freedom in their specifications.

As an example, motor bearings lined with synthetic rubber and operating in oil will greatly lessen troubles which are prevalent with metal bearings. The oil and abrasion resistance of the synthetic make possible the use of rubber in this application. The synthetic has already proved itself as bearing material for marine propeller shafts.

Another use will be the absorption of vibration for heavy machine installations. The synthetic made into tie plates for railroad tracks will be more adaptable and more durable than natural rubber.

The synthetic is finding important uses in combination with cloth and paper. Paper pulp mixed with synthetic is rolled into thin sheets which are water and moisture proof. This material can be used in wrappers for meat, fish, vegetables and many other commodities, without deteriorating. Sheets of paper made in this manner are extremely tough. Thick sheets of the treated paper make an excellent quality of artificial leather, which takes dye, embossing and other finishes.

Another application of particular advantage is the use of synthetic rubber in the impregnation of paper and cardboard, both of which, so treated, have the highly desirable qualities of strength, toughness and durability for many important uses. Chief among these would be containers for oil and grease and cartons for other materials which must be protected from oil, grease and water, even under adverse conditions and frequent rough handling.

Demonstrating effect of oil at 160°F. on rubber. Untreated miniature tire in foreground shows appearance of samples before immersion. Unaffected tire at left is a synthetic rubber; swollen natural rubber tire at right increased 40% in diameter, 180% in volume

Fabrics, also, may be impregnated and coated with synthetics and in such form will be welcomed by many industries, in which clothing, shoes, gloves, boots, conveyor belts and other articles must withstand oil, fats, greases and citrus fruit juices. Made of such material, shoes, overshoes and galoshes will have a natural "shine" which will not require a varnish finish.

Their excellent resistance to abrasion, oil and heat make these synthetics superior to natural rubber in impregnated fabrics for rain coats, porch furniture, hospital sheeting, window shades, oil cloth, linoleum, awnings, tarpaulins, and deck coverings. Synthetics stand up well in hot sunlight and age well without peeling or cracking.

Some synthetic rubbers also are being considered for tubes containing tooth paste, shaving cream and similar products. The top of the tubes will merely be pinched off; the tubes will open when pressure is applied and squeeze shut when it is released.

These synthetics are expected to find a multitude of uses in the home. They may replace all pipes and joints in the entire plumbing system, since flexible pipe made of synthetic may be run into walls, under floors and around corners. The dripping hot water faucet, one of the greatest annoyances of modern life, will be made a rarity by faucet gaskets of synthetics which are inherently resistant to heat. A synthetic rubber also can be used for such household articles as garbage containers and dish drainers, which are destroyed by grease or corrosion when made of natural rubber or many other materials.

In its hard forms, synthetic rubber will be employed in all the present applications of natural hard rubber and, because of its superior resistance to shatter, impact and heat softening, will find many uses beyond the possibility of the natural product. Used as cement, the oil resistant synthetics provide a strong, durable bond for materials never before cemented by natural rubber. One of the newest uses may be the cementing of wood to metal.

While these examples provide some indication of what can be expected from synthetic rubbers, the full possibilities of these versatile materials seem to be limited only by the imagination of engineers, inventors, manufacturers and users.

(Editor's Note: Mr. Parrish goes on to describe the process of manufacture for hycar type of synthetic rubber. His remarks appear below.)

The manufacture of synthetics of high quality and high performance requires the careful design of equipment and exact scientific control of the process. In making hycar synthetics, butadiene is used in combination with acrylonitrile or other similarly reactive chemicals.

Butadiene is shipped to the synthetic plants in tank cars and stored as a liquid under pressure. When left standing alone, it undergoes polymerization and for this reason an inhibitor is added to prevent self-reaction. The inhibitor is removed by distillation just prior to use.

To produce highly oil-resistant hycar synthetic, acrylonitrile is added to butadiene. The synthetic most suited for tires is made by adding styrene to butadiene.

Commercial Process Described

To make hycar on a commercial scale, a soap solution is contained in a huge sealed tank. Through intake pipes, butadiene and acrylonitrile in measured amounts are run in under pressure while contents of the tank are stirred. At this stage, the liquid in the tank has become milky due to the presence of minute particles of synthetic rubber which are suspended in it.

The soap solution contains a catalytic agent to promote formation of the synthetic. When the process is finished, this milky liquid is synthetic latex, quite like the latex drawn off rubber trees in the production of ordinary rubber.

The synthetic latex is drawn off into a large open vat, into which is poured a weak acid or salt solution; as the latex is stirred, the synthetic particles coagulate and come to the top. The synthetic floating on top of the liquid is a cream colored lumpy mass suggestive of cottage cheese. It is skimmed off, lumped into a big block and run between large steel rollers under a stream of water which washes out the soap, acid and other impurities. The material is dried in sheets about $\frac{5}{8}$ in. thick. These crude sheets are tough and hard to tear, rough and cream-colored, with slight odor. They greatly resemble sheets of natural crepe rubber.

In this form, the synthetic is ready to be compounded and vulcanized into tires, hose, gaskets, raincoats and hundreds of other possible products. While proper compounding and processing are important, the quality of these finished products depends to a great extent upon the quality of the raw material.

Oxidation-Corrosion of Lubricating Oils*

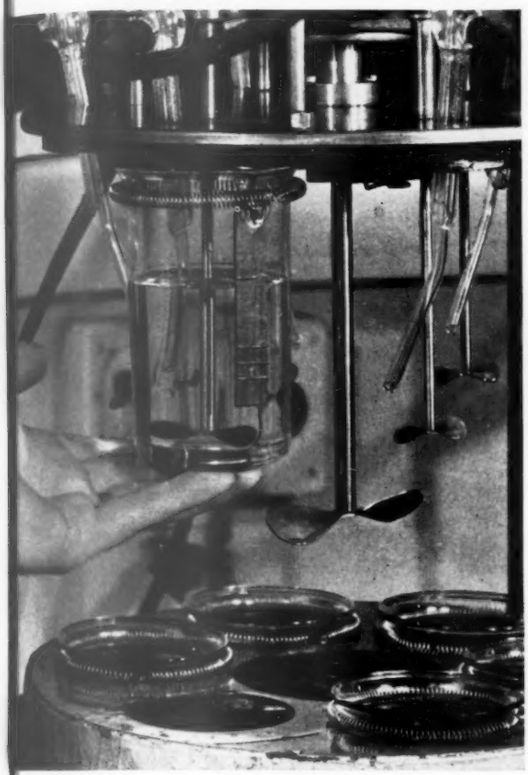

Fig. 1—Detail of beaker, metal test strips, and sealing of beaker

Fig. 2—Oxidation-corrosion test equipment

By C. L. Pope ** and D. A. Hall **

Apparatus and procedure for an accelerated oxidation-corrosion test of industrial lubricating oils is described, from which prediction of the useful service life of these oils can be made. The method may be used to determine at what point in an oil's life corrosion products are formed, and to indicate proper blending of new with used oils to prevent initial corrosion.

Test also will bring out inherent differences in oils, as well as changes in refining technique. This will permit the user to intelligently specify the application of an oil in terms of his individual operations.

SINCE it has been difficult to establish the suitability of an oil for a given service or to compare two given oils except by a practical service test, a rapid laboratory method of accomplishing this was developed. The equipment proved to be well suited to the task of studying the performance of a variety of oils in diversified services.

The work of Rogers (5), Dantsizen (2), and Von Fuchs (3) gave direction to the work, which has now extended to the point where reliable data can be obtained in a short time. The information gained is an aid in selecting the proper lubricant for a given service condition, or in predicting the useful life of an oil.

The apparatus was designed to simulate operating conditions as closely as possible in regard to temperature, agitation, presence of moisture, and metals. The use of a reflux condenser, which returns most of the volatile oxidation products to the oil, and the addition of oxygen greatly accelerated the breakdown of the oil.

The ability of an oil to prevent initial rusting and the period in its life when it begins to cause corrosion were determined by visual inspection of the metal test strip suspended in the oil. Oxidation stability was determined by the rate of rise of neutralization number (1) and by the rate of drop of interfacial tension over water (6).

Apparatus and Test Method

The apparatus is shown in Figs. 1, 2, and 3. These illustrate how heat, agitation, moisture, oxygen, and materials used in machine construction are applied to the oil under test. The reaction chamber was a 400-ml. tall form beaker without lip. The rim of the beaker was ground and fire-polished until it was quite level. A glass hook, welded to the inside of the beaker near the top, served to hold the metal test strip. A 250-ml. sample of the oil to be tested was placed in a beaker and mounted in the constant-temperature oil bath. The samples were stirred at 850 rpm. and the oil bath at 600 rpm. by stainless-steel paddles mounted on stainless-steel rods. A reflux condenser protruding through the tight-fitting Koroseal cover served to return most of the volatile oxidation products to the reaction. Oxygen, after saturation with moisture by passing through a Milligan gas-washing bottle, was admitted at a constant rate of 3 liters per hour through a tube inside the condenser (3). A tight-fitting cover was assured by a coiled-wire spring under the rim of the beaker, and by a layer of sponge rubber backing the Koroseal cover. The cover, condensers, stirring rods, and driving motor were all mounted on a brass plate which could be raised or lowered on three vertical supporting rods. The reaction temperature of 100 C. was maintained constant within plus or minus 0.5 C. by means of a 500-watt Lolag heating unit and a mercury thermo-regulator. The type of test strip depended upon the use to which the oil under test was to be put, since the test strip was to be representative of the materials used in machine construction. For turbine oils, a strip of S.A.E. 1020 steel, 1/16 in. by $\frac{5}{8}$ in. by 3½ in., wound with three turns of No. 18 copper wire, was used. In testing Diesel oils, silver-cadmium or lead-copper metal assemblies were employed. Before any test was made, all surfaces which would be in contact with the oil were first cleaned with a solution of equal parts by volume of acetone and solvent naphtha, and then dried.

The sample was inspected every 24 hr. for color change and corrosion, and a sample was withdrawn for interfacial tension test against distilled water, and also for neutralization number. At the end of 96 hr., the sample was tentatively placed in one of three general classifications of oxidation stability:

Group 1—Oils losing less than 5 dynes per cm. interfacial tension;

Group 2—Oils losing more than 5 dynes per cm., but having greater than 15 dynes per cm. interfacial tension;

Group 3—Oils having less than 15 dynes per cm. interfacial tension.

Further testing was then continued on the basis of the estimated duration of the test. If the oil was in group 1, it was inspected and tested every 100 hr., until the interfacial tension dropped below 15 dynes per cm. If the oil was in group 2, it was inspected and tested every 24 hr., until the interfacial tension dropped below 15 dynes per cm. If the oil was in group 3, the test was considered as having been completed.

Interfacial tension (6) was measured with a duNouy interfacial tensiometer (3). A 150-ml. beaker which had been cleaned with hot chromic acid and then rinsed thoroughly with

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** Eastman Kodak Co., Rochester, N. Y.

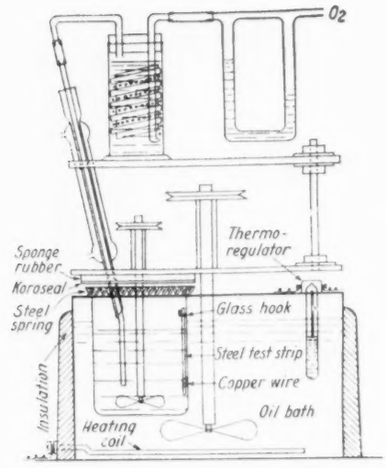

Fig. 3
Detail drawing of oxidation-ocrrosion tester

distilled water was filled with distilled water to about 1 cm. from the top. The flamed platinum ring was submerged in the water and then about 10 ml. of oil was poured on the surface of the water. After 5 min., the two phases were assumed to be in equilibrium and the interfacial tension was then found by measuring the force necessary to pull the ring through the interface.

Reproducibility of Results

Duplicate samples of any oil gave identical corrosion records and had oxidation stabilities differing by not more than 10 per cent, figured in hours required to reach an interfacial-tension value of 15 dynes per cm.

Analysis of Results

Corrosion was graded as A, B, C, or D; grade A being no corrosion and grade D being very bad corrosion, as shown in Fig. 4. Thus, this test showed not only the ability of an oil to shield clean metal surfaces from the effects of moisture alone, but also the point in the life of an oil when it caused corrosion of the metal surfaces with which it was in contact. Corrosion in the first 24-hr. period was probably due to lack of protective ability, and may be described as intermittent or spotty (No. 1, Fig. 4). Corrosion developing after 24 hr. was due to a change in character of the oil as a result of oxidation, and was generally uniform and continuous (No. 2, Fig. 4). Oxidation stability was judged primarily by the rate of drop in interfacial tension and by the rate of rise in neutralization number; and, secondarily, by the change in color of the oil, by the presence of sludge, and by the appearance of the test strips. Interfacial tension was a better single criterion of the condition of an oil than neutralization number, because the range of interfacial tension generally changed from 40.0 to 50.0 for a new oil to 12 to 18 when the oil was unsuited for further service. Neutralization number, on the other hand, may have changed only from 0.10 for a new oil to 0.20 before it was unsuited for further service.

Correlation with Rusting Tendencies

It is unfair to expect an oil to protect ferrous materials from moisture under all conditions of operation. However, the oil in most splash- and bath-lubricated equipment contains traces of moisture resulting mostly from condensation, and an oil for such service must protect the equipment under normal conditions of moisture. Two oils refined by different methods permitted rusting of gears and ball bearings in 47 sets of reduction gears in widespread use. These oils are rated C in the oxidation-corrosion test. These same reduction gears, with working parts replaced, have shown no signs of rusting since using two oils rated B in the same test.

Correlation with Service Life

Correlation of the results obtained using this laboratory equipment with the results in actual service requires considerable time and patience, as very little equipment in service lends itself to uniform oil performance. Such common things as mechanical adjustments, temperature range, materials of construction, amount of make-up oil added, etc., all markedly influence oil performance (4). Nevertheless, two turbine oils ran 5500 hr. and 10,500 hr. in service, and 96 hr. and 205 hr., respectively, in the laboratory test.

Two other turbine oils, as shown in Fig. 5, have probably lost about 20 per cent of their useful lives. Oil No. 5A is oil No. 5 after 12,000 hr. of service. Likewise, oil No. 24A is oil No. 24 after an equal length of service. Curves for oils Nos. 5A and 24A, if shifted 100 test hours, are practically superimposed on oils No. 5 and No. 24, respectively. If the oxidation-corrosion test is run on an oil before it is put in service and also periodically while the oil is in use, the remaining useful life of the oil can be estimated at any time. As a matter of fact, an interfacial-tension reading taken periodically gave a fair idea of the remaining useful life of an oil after the oxidation-corrosion test had been run on the new oil.

The use of the accelerated testing method soon verified an observation made by Von Fuchs (3), namely, that it was possible to prevent initial corrosion under some conditions of operation by adding a quantity of used oil to a new oil which was unable to prevent rusting. Further, the test was used to determine the nature and quantity of such addition. Oil No. 24 is oil No. 5 with 7 per cent used oil added to prevent initial corrosion (2). The addition of the used oil evidently sacrificed about 17 per cent of the life of the lubricant. The used oil to be blended with a new oil should be carefully selected. If possible, the two should be of the same make. If the used oil was not oxidized too much or if too much was added, it hastened the breakdown of the new oil unnecessarily. Preliminary blending of the new oil with available used oils should be carried out; and the blends should be tested in the oxidation-corrosion machine to determimne not only the best oil,

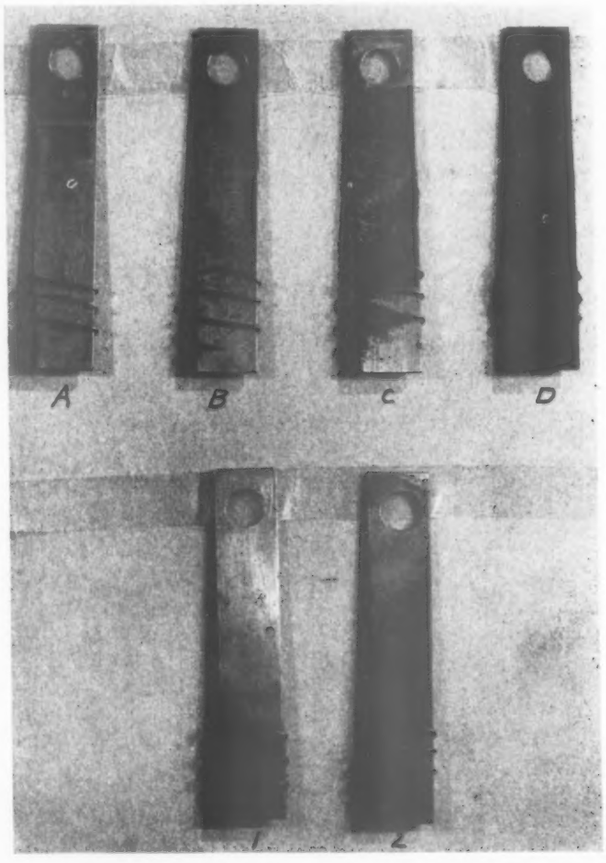

Fig. 4—Test strips after immersion in the tester

but the proper amount to be added. (At the suggestion of the authors, an additional reference is cited, namely, the paper by M. D. Baker of West Penn Power Co. "Wanted—A New Turbine-Oil Test", *Power*, May, 1941, p. 64. This paper brings up the question of addition of used oil to new oil in order to prevent rusting—Ed.)

The accelerated test brought out unmistakably inherent differences in oils, but did not indicate their best use. For example, Fig. 6 shows typical oils of three general types: No. 28 is a nonsolvent refined oil; No. 30, a solvent refined oil; and No. 26, a well inhibited, solvent refined oil. Any one of these general types has its particular field of usefulness. For instance, oil No. 28 has given good service on geared turbine where the bearing temperature did not exceed 145 F., but where a high film strength apparently was needed. Oil No. 30 has a longer service life from the standpoint of the oil, as might be predicted from the data, but allowed wear of the gear teeth on these same turbines. An oil similar to No. 26 has given excellent service on high-temperature turbines where the less stable oils break down rapidly.

The oxidation-corrosion test may be used to dispel widespread misconceptions as to the capabilities of lubricants. Furthermore, if a manufacturer of lubricants changes his refining technique or source of crude oil, it is usually reflected in a different shape of the curves for interfacial tension and neutralization number. Most changes in lubricants are presumably made for the better, but the user might suffer if he is not aware of a change, or if he does not know how to interpret the change in terms of actual use. As an example, in Fig. 7 are shown two oils of the same brand name. Oil No. 13 was purchased in 1935 and oil No. 14, in 1942. The method of refining and the stability of the oil have evidently been changed in the past 7 yrs., although the usual physical characteristics of the two oils are quite similar (Table I). It should be noted that the 1935 oil reached a high neutralization number with a rather flat interfacial-tension curve. The 1942 oil had a typical

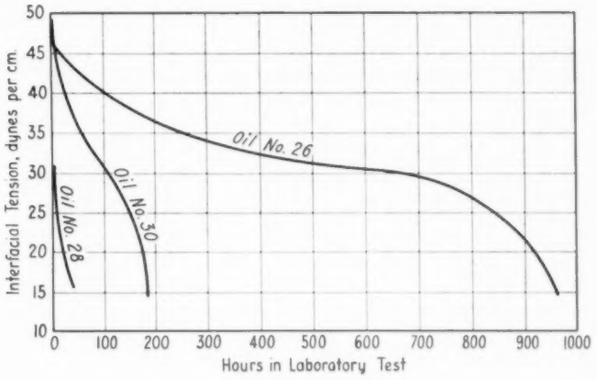

Fig. 6 (Right)—Plot of change of interfacial tension vs. hours in tester for three oils

interfacial-tension curve and a rather flat neutralization curve.

Table I.

Physical Characteristics	1935 Oil	1942 Oil
Gravity	0.893	0.895
Flash Point, deg. Fahr.	495	495
Fire Point, deg. Fahr.	540	545
Viscosity, SUS at 100 F.	1320	1309
Viscosity, SUS at 210 F.	108	112
Pour Point, deg. Fahr.	40	35
Carbon residue	1.25	0.90

On the basis of the 1935 data, it is conceivable that the 1942 oil might have been kept in service until it sludged in the lubricating system, with capital loss to the user; and, conversely, an oil might be discarded long before it should have been. Thus, it can be seen that the test should be run frequently on oils as received, so that the appropriate curve can be referred to after the oil is in service.

Acknowledgment:

The authors wish to acknowledge the invaluable assistance of C. A. Elwood, staff engineer; F. J. Hopkinson, superintendent of the Industrial Laboratory; and V. M. Palmer, superintendent of the Industrial Engineering Department of the Eastman Kodak Co., in fostering this work, guiding it through the early stages, and providing the necessary equipment.

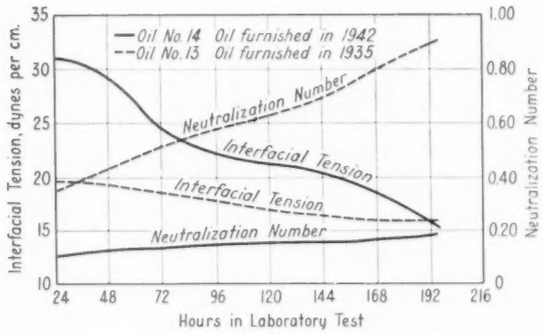

Fig. 7 (Left)—Test of two oils of same brand-name, showing how differences in refining technique alter test results

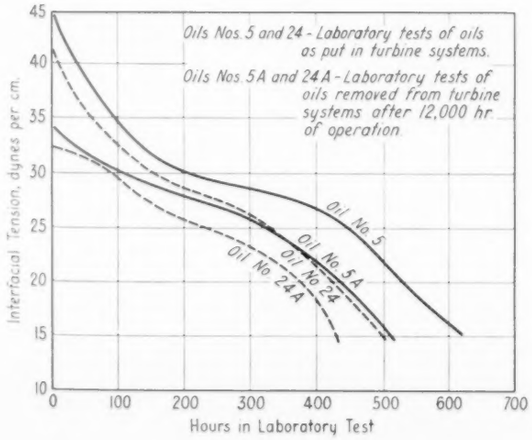
Oils Nos. 5 and 24 - Laboratory tests of oils as put in turbine systems.
Oils Nos. 5A and 24A - Laboratory tests of oils removed from turbine systems after 12,000 hr. of operation
Oil No. 5
Oil No. 5A
Oil No. 24
Oil No. 24A
Interfacial Tension, dynes per cm.
Hours in Laboratory Test

Fig. 5 (Left)—Comparison of new oils with same oils after 12,000 hours of service

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(6) H. H. Zuidema, and G. W. Waters, "Ring Method for the Determination of Interfacial Tension," *Industrial and Engineering Chemistry*, Analytical Edition, Vol. 13, No. 5, p. 312 (1941).

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Recovery of Chemicals from Oil Field Brines Awaits Market for Chloride Compounds

OIL field brines produced along with crude oil in the Mid-Continent and Gulf Coast fields combined contain an estimated quantity of chloride compounds 4.5 times greater than the total annual U. S. consumption of these chemicals. However, although the quantity is great and the underground reservoir itself practically unlimited, production is as scattered as that of oil and gas and present economic conditions do not favor commercial recovery of the brine chemicals.

These points are brought out in a report on the commercial utilization of Oklahoma oil field brines by B. W. Logue, chief chemist, The Texas Co., Tulsa, made to the Mineral Industries Conference at Oklahoma City sponsored by the Oklahoma Geological Survey.

However, authorities state that it may be no more foolish to say, today, that oil companies a few years hence will be recovering valuable chemicals from oil field brines than it was to prophesy a few short years ago, that refiners would be making chemicals and plastic materials from oil and natural gas on a competitive basis with the chemical manufacturing industry.

While it has long been known that valuable chemicals are found in natural brines, now an undesired by-product of oil wells, Mr. Logue reported it is not commercially practicable at present to process Oklahoma's brines because of lower-cost recovery methods utilizing other raw chemicals. But the utilization of stronger brines discovered in other states should be studied, it was said, when positive brine disposal methods are considered, since advances in industrial processing technology may increase the demand for brine chemicals sufficiently to make their recovery practicable.

The Logue report brings out that, as far as is known by the U. S. Bureau of Mines, only one plant is operating in this country to recover chlorides of calcium, magnesium and sodium from brine brought to the surface incident to crude oil production.* The brine thus obtained, in this instance, is supplemented by brine drilled from wells solely for that purpose at an increase in cost of 1 to 2c per bbl. over the oil well brines. This increased cost is justified if the recovery project is extensive, according to Mr. Logue, to insure certain and continuous supply or quality of brine.

Interest centers in the stronger rather than weaker brines for recovery processing. Table 1, from the Logue report, shows the analysis of a typical strong brine from an Oklahoma oil field.

*Taylor, S. S. and Owens, E. O., "Subsurface Disposal of Oil Field Brines in Oklahoma", U. S. Bureau of Mines Report of Investigations No. RI 3603, January, 1942.

Recovery processes, according to the report, may be directed toward recovery of one, two or three products—magnesium, bromine and iodine—or all constituents of the brines.

Magnesium is recovered by precipitation with lime as magnesium hydroxide (7% $Mg(OH)_2$ in water is pharmaceutical "Milk of Magnesia") as a thin, milky suspension, the report states. The precipitate is concentrated in thickeners to a 5 to 8% $Mg(OH)_2$ slurry which may be further concentrated by settling to a 10- to 15% concentration, about as heavy as can be pumped. Concentration up to 40% may be attained by alternate vacuum filtration and water washing, the amount of washing dictated by the degree of purity required. Further processing will be entirely dependent on the end product desired and is considered outside the scope of the report.

However, the report points out, if no other products are to be recovered from the brine, very thorough clarification and probably acidification of the discarded material will be required if sub-surface disposal is contemplated. Otherwise, magnesium in untreated brine would be precipitated and the sand plugged when the two liquids mix.

Bromine is present in Oklahoma oil field brines in concentrations ranging from 300 to 500 parts per million. Extraction may be carried out by a process involving acidification, chlorination, blowing with air and absorption in sodium carbonate solution, which the report indicates is probably covered by existing patents now in force.

Iodine, existing in Oklahoma brines to the extent of 5 to 20 parts per million, may be recovered by two processes both of which have been operated with some degree of success on slightly richer brines. One is similar to the process described for bromine and the other entails precipitation as silver iodide in the presence of large amounts of chloride and bromide; both probably are covered by valid patents now in force, it is said.

Again, the brine probably will require treatment before sub-surface disposal. This authority points out that after strong oxidation to recover bromine, the brine should receive reducing treatment to avoid formation of precipitated ferric oxide in the fresh brine, thus plugging sub-surface strata.

Table 1—Analysis of Sample of Strong Oklahoma Oil Field Brine

(Specific gravity, by hydrometer at 78° F., 1.132)

Determined:	Weight %	Weight Pounds Bbl.
Total weight	.	396.
Calcium, Ca	1.085	4.30
Magnesium, Mg	0.214	0.85
Potassium, K	0.107	0.42
Iron Oxide and Alumina, R_2O_3	Trace	Trace
Ammonia, NH_3	0.004	0.016
Chloride, Cl	10.70	42.4
Bromide, Br	0.0330	0.13
Iodide, I	0.0010	0.004
Sulfate, SO_4	0.0014	0.006
Sulfide, S	0.0003	0.001
Carbonate, CO_2	0.005	0.019
Strontium, Sr	present	present
Sodium, Na (to balance)	5.24	20.8
Probable Combinations:		
Sodium Chloride, NaCl	13.3	52.7
Sodium Bromide, NaBr	0.043	0.17
Sodium Iodide, NaI	0.001	0.004
Potassium Chloride, KCl	0.204	0.808
Calcium Chloride, $CaCl_2$	2.99	11.9
Calcium Sulfate, $CaSO_4$	0.002	0.008
Calcium Carbonate, $CaCO_3$	0.011	0.044
Magnesium Chloride, $MgCl_2$	0.84	3.33
Ammonium Chloride, NH_4Cl	0.012	0.05
Hydrogen Sulfide, H_2S	0.0003	0.001
Iron Oxide and Alumina, R_2O_3	Trace	Trace
Strontium Sulfate	Trace	Trace
Total Solids (calculated)	17.4	69.0

Recovery of Total Solids

Assuming a brine charge of composition similar to that given in Table 1, the report gives the following succession of processing for the recovery of total solids:

"The first step would probably be precipitation of hydroxides of iron and aluminum by a light treatment with lime or the precipitation of iron aluminum and magnesium by a heavier treatment with lime. If a high yield of magnesium is desired, calcined dolomite might be substituted for lime. Whether magnesium is removed at this stage will depend on the ultimate form to which magnesium is to be processed. For some purposes the magnesium hydroxide would be precipitated and purified as described above; but if magnesium chloride were the final objective then the magnesium would be left in the brine until after removal of most of the common salt.

"Common salt is obtained by evaporation of the brine. The precipitated salt is removed from the evaporator, washed and dried. Then follows marketing of the produced salt which is a problem in itself comparable with production. The trade, long accustomed to a buyer's market, is critical of crystal size and shape, packaging, caking, etc.

"The choice of evaporating equipment will constitute a major problem of design of the plant. Multiple effect vacuum evaporators probably represent the preferable type.

"In the course of evaporation the concentration of calcium chloride will build up; at about 14 to 18% calcium chloride the sodium chloride becomes unfit for marketing without recrystallization because of small crystal size and high percentage of impurity. The solution at this stage is known to the industry as bittern. Analysis of a typical sample of bittern** derived from the brine of Table 1, is shown in Table 2. Magnesium was precipitated before the initial evaporation.

**Used in the salt manufacturing industry to denote waste liquors containing calcium and magnesium sulfates.

"Further refining from this point might take devious routes. In view of the present high demand for magnesium chloride a process for exchanging the chloride radical from the calcium to applied magnesium hydroxide appears most desirable. Calcium chloride at this stage is more of a liability than an asset and such a conversion would accomplish disposal of calcium chloride and production of magnesium chloride. The ammonia-soda alkali process (Solvay—Ed.) has in the past produced large quantities of calcium chloride only a small portion of which could be marketed***. A successful commercial process is now reported by which the above conversion is being effected. The writer has had no experience with the process but the following chemical reaction is presumed to represent an outline of the process:

$$\underset{\text{solution}}{CaCl_2} + \underset{\text{solid}}{Mg(OH)_2} + \underset{\text{gas}}{CO_2} \rightarrow \underset{\text{solid}}{CaCO_3} + \underset{\text{solution}}{MgCl_2} + H_2O$$

"In order to provide both of the two reagents, magnesium hydroxide and carbon dioxide, a kiln or kilns for burning magnesite or dolomite, and utilization of kiln gases in the carbonation step would be required. Magnesium chloride is filtered from the precipitated calcium carbonate.

"If the calcium chloride is not processed to magnesium chloride it may be evaporated to 60% $CaCl_2$, flaked, dried and marketed as 75% calcium chloride.

"Bromine and iodine may be left in the calcium chloride or either or both may be recovered from the bittern.

***U. S. Bureau of Mines Minerals Yearbook, 1940.

"Potassium chloride, if left in the calcium chloride, will cause trouble in connection with marketing of the latter. A considerable portion of the potassium chloride can be removed by cooling the calcium chloride solution after concentration to 50% $CaCl_2$.

"The economics of extraction of constituents of Oklahoma oil field brines would not be complete without some consideration of the competitive position.

"In respect to common salt, long established production is found in southern Kansas at Lyons and Hutchinson and in North Texas at Grand Saline. Salt is produced both by mining and by sub-surface dissolving of rich salt deposits with fresh water and evaporating a saturated brine thus obtained. Oklahoma natural brines, not entirely saturated and containing considerable calcium chloride, would be under a handicap.

Table 2—Analysis of Bittern Derived From the Brine of Table 1**

(Specific gravity, by hydrometer at 60° F., 1.249)

Determined:	Weight %	Weight Pounds Bbl.
Total weight	.	437.
Calcium, Ca	5.79	25.3
Magnesium, Mg	Nil	.
Potassium, K	0.434	1.90
Iron Oxide & Alumina	Nil	.
Silica, SiO_2	Nil	.
Chloride, Cl	17.34	75.8
Bromide, Br	0.117	0.51
Iodide, I	0.0038	0.016
Sulfate, SO_4	0.022	0.10
Carbonate, CO_2	0.0076	0.03
Hydroxide, OH	0.005	0.02
Strontium, Sr	present, not estimated	
Probable Combinations:		
Sodium Chloride, NaCl	11.11	48.6
Sodium Bromide, NaBr	0.15	0.66
Sodium Iodide, NaI	0.005	0.02
Potassium Chloride, KCl	0.93	4.1
Calcium Chloride, $CaCl_2$	16.0	69.8
Calcium Sulfate, $CaSO_4$	0.03	0.13
Calcium Carbonate, $CaCO_3$	0.02	0.09
Calcium Hldroxide, $Ca(OH)_2$	0.01	0.04
Total Solids (calculated)	28.2	123.4

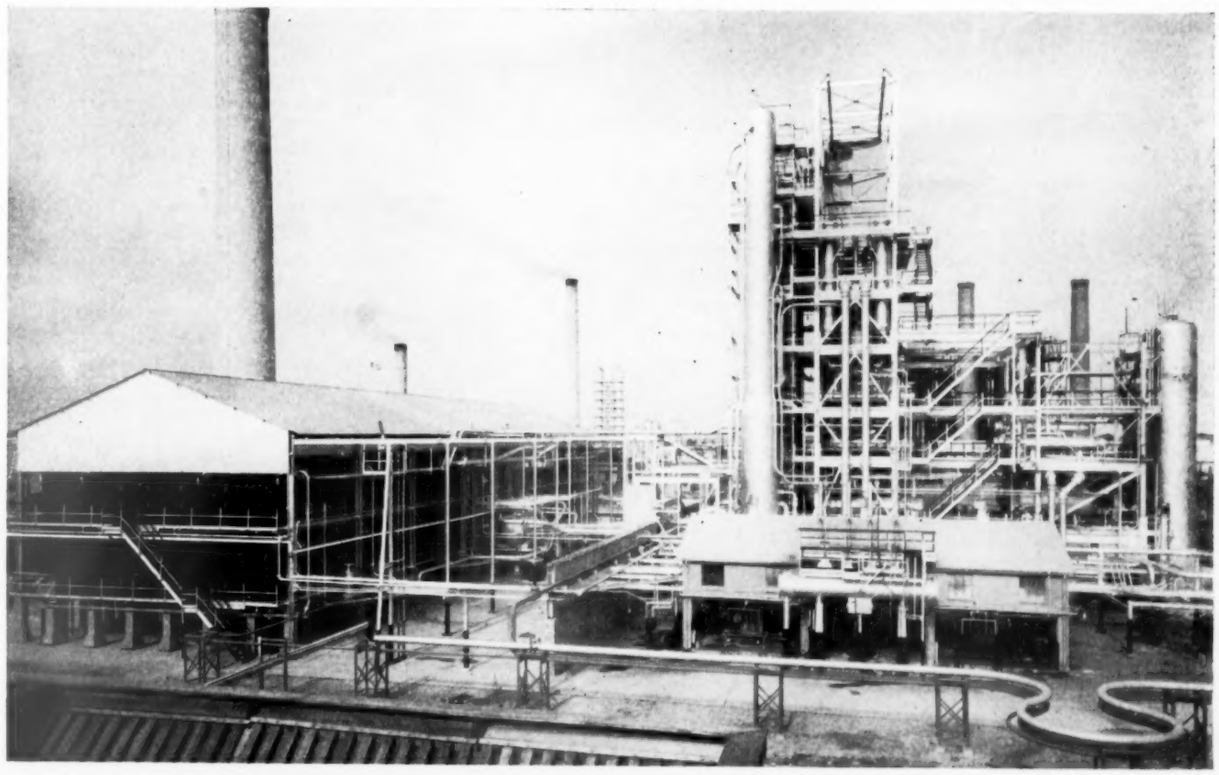
"The magnesium concentration of sea water is almost as much as that of Oklahoma brines and sea water has the advantage of unlimited quantity easily obtainable and presenting no difficult disposal problem. Similarly natural brines have been found in Michigan, Texas, New Mexico and Utah having magnesia contents more than 10 times that of the richest Oklahoma brines known to the writer. Magnesium products are also being obtained in increasing quantity from solid minerals such as magnesite, brucite, dolomite, serpentene and olivine.

"The greater portion of the bromine production of the nation comes from sea water in which the concentration of bromine is only one-fifth that of Oklahoma brine but the main producer, Dow Chemical Co., has passed up natural brines of double the bromine content of Oklahoma brine in favor of sea water.

"Iodine can be produced as a by-product of the Chilean nitrate industry in excess of world demand. Iodine recovery in the U. S. from a brine of 80 parts per million—considerably richer than any known brines in Oklahoma—has been operated and abandoned.

"As has already been stated, calcium chloride is more of a liability than an asset to brine recovery operation.

"The concentration of potassium in any Oklahoma brines with which the writer has knowledge is too low to make recovery of that element commercially feasible."



Polyform plant for the manufacture of high octane gasoline (Photo from the Lummus Co.)

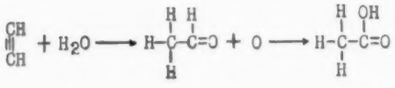
Potential New Sources for Butadiene

Acetylene, Now Producible by Low Cost Methods, May Prove Suitable Raw Material; Manufacture of Butadiene as Direct Product of Cracking Hydro-Carbons Also being Studied

By Harold F. Crow

RECENT reports of new developments in the manufacture of acetylene may have an important bearing on the production of synthetic rubber. In the last few years, acetylene has been used in commercial syntheses of other organic compounds. It may be obtained from calcium carbide as follows:

Acetylene is then converted to acetaldehyde and finally to acetic acid.



Acetylene Acetaldehyde Acetic Acid

This is now a large industry.

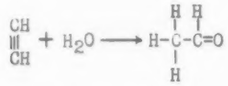
Acetylene can also be obtained by passing a rapid stream of hydrocarbon gas through an electric arc or a silent discharge. Temperatures of 1100° C. or 1500° C. may be required. It is difficult to find materials which will completely withstand such temperatures and that are at the same time non-catalytic.

After passing through the electric arc and being heated to a sufficiently high temperature, the mixture is quickly quenched. Appreciable amounts of acetylene are then obtained, but for a really satisfactory yield it is necessary to work at reduced pressure, perhaps even as low as 0.1 atmosphere. Power costs are high, and there is not much advantage gained over the older method of using calcium carbide.

The method of straight pyrolysis has the recommendation that the heat produced by burning the by-product gases can be utilized. These consist mainly of hydrogen and methane. In this way, the energy required for the process is supplied by the raw materials. The result is a saving of electric power, and also the plant can be located near the supply of hydrocarbons irrespective of whether or not there is cheap electric power in the district.

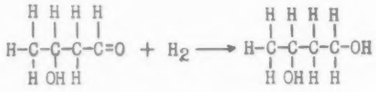
There are several ways of converting acetylene into butadiene, which is the raw material for the synthetic rubbers of more general application. One method which is of technical importance is to convert the acetylene into acetaldehyde, which passes through the aldol conversion, and finally yields butylene glycol. This, in turn, is converted to butadiene. The reactions may be represented as follows:

1—Acetylene to acetaldehyde:

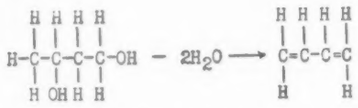


2—Acetaldehyde to adol:

3—Aldol to butylene glycol:



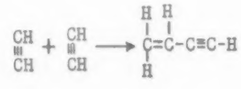
4—Butylene glycol to butadiene by removal of water:



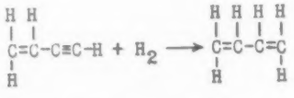
Acetylene can also be used as the starting point in the preparation of vinyl acetylene, vinyl acetate, tetrachlorethane and trichlorethylene.

There is another method of obtaining butadiene from acetylene. In this process, vinyl acetylene is an intermediate product. This latter compound is reduced by catalytic addition of hydrogen, and butadiene results. The reactions may be represented as follows:

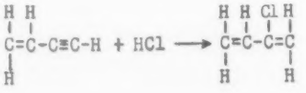
1—Acetylene to vinyl acetylene:



2—Vinyl acetylene to butadiene:



The process resembles that used for the manufacture of chloroprene. Chloroprene is produced as follows:



If the hydrochloric acid is replaced by hydrogen, then butadiene is formed as shown above.

In the manufacture of synthetic rubbers, as with all high polymers, it is essential that the raw materials have a high degree of purity. Quite small amounts of impurities seriously affect the degree of polymerization at a later stage and the final product is unsatisfactory.

There are many difficulties in the way of producing butadiene in a high state of purity when starting from petroleum products, especially when these are the products of cracking operations. To some extent, this also applies when the raw material is agricultural produce, particularly if these materials are obtained by fermentation processes. This fact is one of the major causes of the difficulty and expense in the manufacture of butadiene from these sources. For this reason, acetylene may eventually prove to be a more suitable raw material, in which case, as the synthetic rubber industry expands, the demand for acetylene will grow very rapidly.

The question may be asked why the butadiene is not produced as a direct product of the cracking of hydrocarbons, but is only obtained by some further reactions of other products of pyrolysis.

The answer probably is that until recently butadiene has not been of sufficient economic importance to warrant any extensive research work necessary to discover and develop a process which would give a really satisfactory yield.

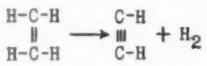
The underlying reactions taking place during the cracking of petroleum are still not clearly understood despite the large amount of research work which has been carried out on the subject. Thermal and catalytic reactions do not end in equilibrium, and the composition of the products varies depending on the conditions under which the reaction is carried out, such as temperature, concentration of the reactants, and time allowed for the reaction to take place.

Cracking stocks consist essentially of hydrocarbons of the following classes: paraffins, naphthenes and unsaturated and aromatic hydrocarbons. Various combinations of these main classes frequently occur in cracking stocks as well as in all petroleum products. The unsaturated hydrocarbons are almost entirely absent in straight-run products, but they

are easily formed in the first stages of cracking. Under these circumstances, the unsaturated hydrocarbons formed are chiefly straight chain mono-olefins, the cyclo-olefins and diolefins being of secondary importance. Derivatives of acetylene do not occur in cracking stocks to any appreciable extent.

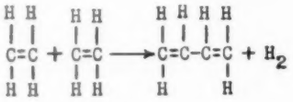
The depolymerization of olefins is perhaps the simplest of their reactions. There are two other types, dehydration and splitting into a paraffin and a diolefin. Both of these reactions take place in the advanced stage of cracking, particularly at high temperatures. The dehydrogenation of ethylene to acetylene is possible at about 1000° C.

The reaction is represented as follows:

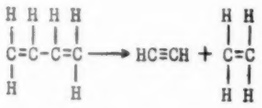


This reaction cannot take place to any appreciable extent at the temperatures at which commercial cracking operations are carried out for thermodynamic reasons. At the present time, information is lacking, and it is not possible to compute accurately the free energy of decomposition of olefins in forming diolefins such as butadiene.

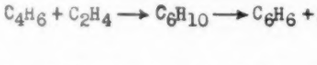
Little, if any, butadiene would be formed from butylene below 600° C., and the indications are that the maximum yield of butadiene would be at about 650°—700° C., and even then it would be low. The decomposition of ethylene at 725° C. and 0.2 atmospheres pressure has been studied. The chief products are butadiene and hydrogen under these conditions. Probably 2 molecules of ethylene react together to form butadiene, and the reaction would then be:



A yield of 21% has been recorded. At higher temperatures, up to about 850° C., the pyrolysis of ethylene yielded as much as 30% butadiene. Above this temperature, the reaction was reversed to some degree and the butadiene split up into acetylene and ethylene as follows:



Also butadiene and ethylene may react to form cyclohexene which then becomes dehydrogenated.



This may be how cyclic olefins arise in cracking. Butadiene is very reactive at the ordinary temperatures of cracking, and at higher temperatures and at low pressures butadiene and ethylene react to form benzene and hydrogen. Now that the technique of operating at high temperatures and low pressures is being mastered, further research may reveal a satisfactory way of obtaining butadiene direct.

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R-285

Wartime Standards for Conserving Motors, Lighting Installations in Refineries

732.9
749.1

Means for the conservation of electric motors and lighting installations in refineries during the war emergency have been worked out by the manufacturing department of Socony-Vacuum Oil Co., Inc., and issued to plant designers and operators.

They provide for the selection of standard motors in place of special types, wherever they can be used, to ease the demands on motor manufacturers. Also, in estimating horsepower requirements, the wartime standards call for taking the full load rating as 110% of the name plate horsepower at 40C (104F). Since the manufacturers' ratings are based on this ambient, or encompassing, temperature, which is actually experienced only at brief periods at most plant locations in this country, motors can be operated at this higher load rating without exceeding the normal total temperature, which would tend to shorten the life of the equipment.

Open type motors are to be used in outdoor locations where savings in permanent housing or other materials can be effected, and enclosed in housings of transite or other available fireproof material. Conventional outdoor lighting fixtures are to be used wherever practicable. The emergency standards for motors and lighting installations of this company are as follows:

Motors

"For semi-hazardous and non-hazardous outdoor locations use splash-proof motors or conventional open type general purpose motors provided with separate weather-proof housing. For indoor locations use open type motors.

"For hazardous locations use explosion-proof motors or open type motors provided with a suitable housing supplied with a reliable independent air source taken from a non-hazardous area.

"In sizing open motors consider the full load rating as 110% of the name plate horse power at 40°C.

"Except in cases where end thrust is encountered, use ring oil lubricated sleeve bearings for open and splash-proof motors.

"Fabricate housings for open motors of light steel frame covered with transite or other readily available fire-proof material.

Starting Equipment

"Locate starting equipment in non-hazardous area.

"For a group of 440 volt motors use open fused switches or circuit breakers and magnetic starters mounted in a common non-weather-proof cabinet fabricated of light steel frame and covered with transite or other readily available fire-proof material.

"For individual or a small group of 440 volt motors use combination starters with sheet steel enclosures. Provide suitable shelter over starting cabinet and individual starters to afford protection against the undesirable effects of sun and rain.

"For 2300 volt motors use fused cutouts and weather-proof starters and mount on elevated pole structure.

Conduit and Wiring for Motors

"For underground circuits use transite or equivalent conduit and 600 volt plastic or lead and varnish cambric insulated wire for 440 volt motors. For 2200 volt motors use 3000 volt lead and varnish cambric insulated copper wire. For above ground circuits within plant limits use rigid steel conduit and 600 volt plastic or braided varnish cambric insulated wire for 440 volt motors and 3000 volt braided varnish cambric insulated wire for 2200 volt motors.

"Where open motors are used in hazardous areas use conduits of larger size having water tight joints (such as J. H. flex-joint or equal) and conduct clean air to motor housing by way of the conduit.

"Except for extremely long runs, use conductor sizes as given in the 1943 California Electrical Safety Orders.

Lights

"Use conventional outdoor lighting fixtures in all locations which are not hazardous or semi-hazardous.

"Use vapor proof fixtures in hazardous and semi hazardous locations except where appreciable vibration is encountered, in which case use explosion-proof fixtures.

"Use guards for vapor-proof fixtures only where the fixtures are near the ground or platform level and are subject to mechanical breakage.

"Use transite or equivalent conduit where conduit is installed underground.

"Use steel conduit and obround condulets with gasketed covers for all conduit systems installed above ground out of doors, or in hazardous or semi-hazardous areas.

"Enclose switches, appliances, etc. that create sparks in operation and are located in hazardous or semi-hazardous areas, in explosion-proof enclosures having all conduit runs sealed.

"Where feasible use enclosures fabricated of Standard C.I. pipe fittings suitable for 125 lbs. S.W.P. for enclosing special switches, relays, and other devices having sparking contacts which must be installed in hazardous or semi-hazardous areas.

"Use 600 volt plastic or lead and varnish cambric insulated wire for underground installations and braided varnish cambric or code rubber covered copper wire for above ground installations. Use bare wire for the solid grounded neutral."

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